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AUTOMOTIVE INDUSTRIES

VOLUME 55 *Philadelphia, Thursday, September 30, 1926* NUMBER 14

Industry Continues Production Progress

New strides made during past year toward higher efficiency and lower costs

A VAST amount of continuous, detailed improvement of manufacturing methods and practices, the fundamentals of which have been long established, and installation of a few radical innovations in production operations—this has been the story of automotive production development during the last twelve months.

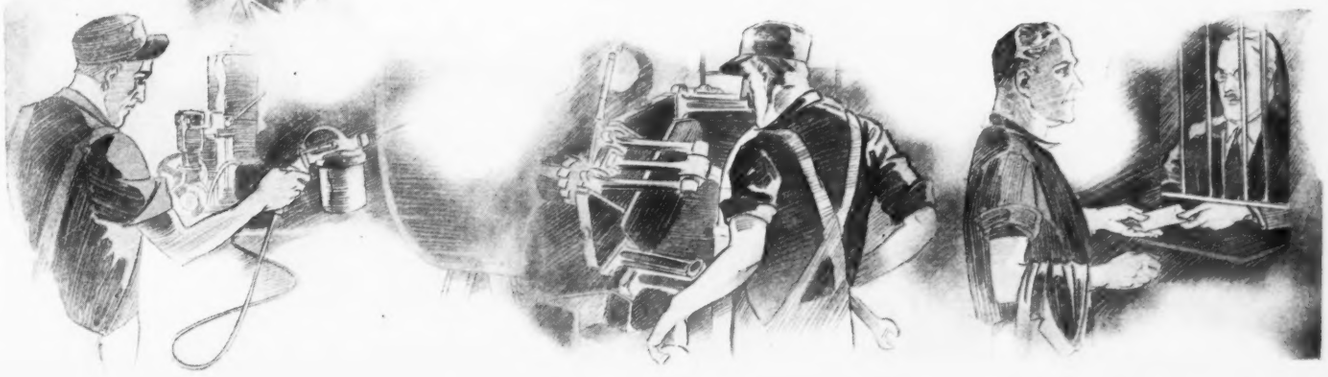
Day in and day out hundreds of manufacturing men have continued their active efforts to cut production costs and no mean measure of success has been achieved, despite the high point of efficiency which already had been attained.

High Lights Emphasized

To summarize in the confines of a single volume all of the multitude of details involved in this progress would be difficult of accomplishment, but to bring out the high lights of some of the more important improvements in certain aspects of automotive production is both possible and desirable. That has been the aim of this 1926 Production and Factory Equipment Issue.

In the issue are discussed such phases as the following: The ever increasing effectiveness with which material handling equipment is being applied to automotive problems; automotive grinding developments of the last year or two; utilization of compressed air in building automotive products; experiments in paying indirect workers on an incentive basis; electric control in automotive plants; manufacturing replacement parts, and special methods of performing a number of important automotive production operations.

Following these specially prepared articles are comprehensive summaries of developments at the production meeting of the Society of Automotive Engineers, at the convention of the American Society for Steel Treating, and at the steel and machine tool exhibition held in connection with the A. S. S. T. meeting.



Electric Control Becomes *in* Automotive

Output accelerated and floor space is saved by application to all types of shop equipment

By Walter L. Carver

ELECTRIC power is recognized clearly as the foundation upon which the present day industrial scheme is constructed. Twenty years ago the annual consumption of electric power for industrial purposes was approximately one billion kw. hr. Last year it was about thirty times as great.

Chain lightning long has been a popular expression for rampant energy and this expression fits this almost incomprehensible supply of electric power until the modern methods of industrial control are introduced into the metaphor. In fact, without the control facilities which are in common use the present elastic utilization of electric power would be impossible and the campaign of making two blades of grass grow in the automotive shop where one grew before would be extremely difficult of achievement.

Nowhere are the results of development along parallel but apparently unrelated lines shown so completely as in the modern automotive manufacturing plant. Like all steady development, the progress which has been made is not immediately apparent but requires some retrospection for the purpose of establishing a basis of comparison. Particularly is this true of the the physical make-up of the modern plant. The development of machinery and methods is reflected in the price and quality of the modern car. But behind the actual machinery is the motive power and, of equal importance, its control.

Visualize for a moment the first class production department of ten, or, in many instances, even five years ago. First, a maze of belts was half concealed in the dim light which trickled through windows covered with stray belt dressing and oily mist from countershafts. Naturally, production cost was high in so far as metal and physical effort and eye strain were involved. Here and there an oiler worked his way up through the wilderness with an occasional shut-down of an entire line of machines. And occasionally one of these oilers was taken to the hospital in pretty bad shape.

Of equal advantage to the management, machines were forced to go to the source of power instead of the power coming to the machine at the right location. Regardless of the type of machine, it had to be set in line with the countershaft. Grouping to eliminate trucking was almost impossible without further complication. Floor space was wasted, as is witnessed by the fact that during the rapid expansion of the past five years, manufacturing space in established plants has not increased in proportion to the volume of output.

Then from the angles of power consumption and production return from expenditure for power, trouble at one machine or countershaft meant a shutdown of an entire line. Big motors took up a lot of floor space and were difficult to handle when repairs were necessary. Overtime work on one small job compelled the operation of a large motor engaged chiefly in overcoming the friction of line and countershafting with a current consumption comparable to full load operation. Inordinate power bills brought lectures on the power factor. How many motors were burned out due to unskilled manipulation of hand starters? And how many starters were put out of business and fires and injuries occasioned by arc-ing?

Motor capacities always were specified from 40 to 100 per cent high for protection against overloads and even

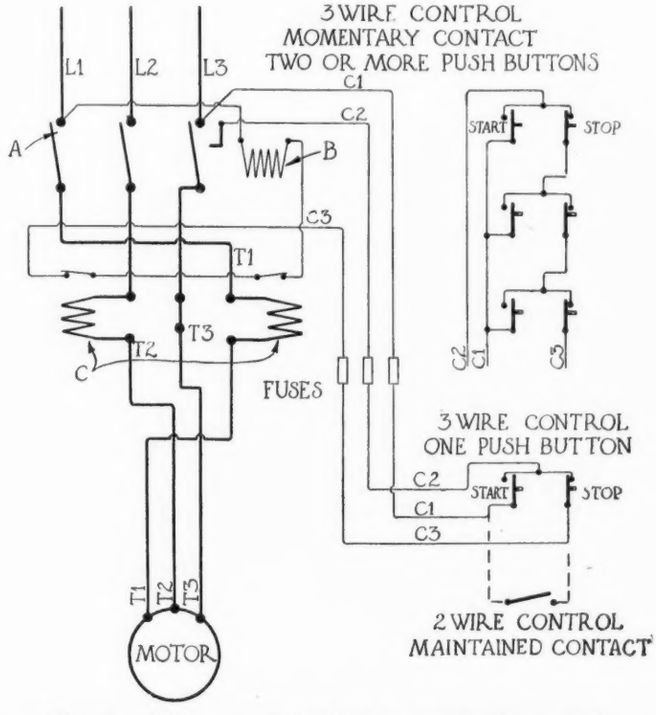


Fig. 1. Diagram of typical across-the-line switch showing three optional methods of button or remote control

Vital Factor Production

then they burnt out before some machine hand could reach the switch. But what about the fuses in this case? Well, experienced maintenance men and plant electricians can remember finding three or four fuses inside of one cartridge. And machine bolts or spikes were specific panaceas in the minds of machine operators who measured the affairs of the world by so many pieces at so much per piece. From the angle of those who had to make operation profitable, the only difficulty was the mortality rate among motors and transformers which entailed partial or complete shut-downs all too frequently. A horrible picture on the whole, but many plants made money in those days of cash deposits and more owners than automobiles.

Now, without any blare of trumpets, electric control has come into its own. Advanced thinkers within the automotive industry started the movement toward smaller units and more motors. Regardless of who started the tendency, the answer is shown by the new machine tools of today. Practically every one has its own motor requirements built in or incorporates provisions for a motor mounting. Machine tool builders report that as high as 90 per cent of inquiries specify individual motors.

Consequently the production shop of today is the reverse of the dark picture of a few years back which has been painted earlier in this article. To state that push button control of electric units is largely responsible for this condition is no exaggeration. With push buttons of various types may be included all of the wide variety of electric controls which remove all responsibility for motor operation from the province of the unskilled or occasional skilled operator. Shops have been cleaned up, machines have been grouped to better advantage in smaller floor space, motor specifications agree more closely with specified loads and lost time due to motor, transformer and line troubles has been reduced to a striking degree. All of these factors are in direct line with the idea of building a better product at a lower price which characterizes this unusual industry.

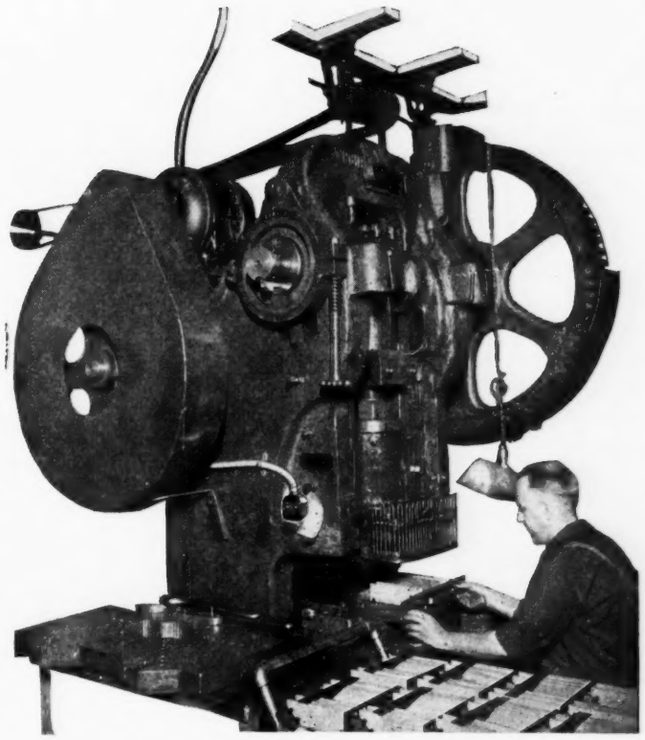


Fig. 2. Simplest form of button control. "Start" and "stop" buttons in box at side of frame. Controller at back of machine and motor near top of frame

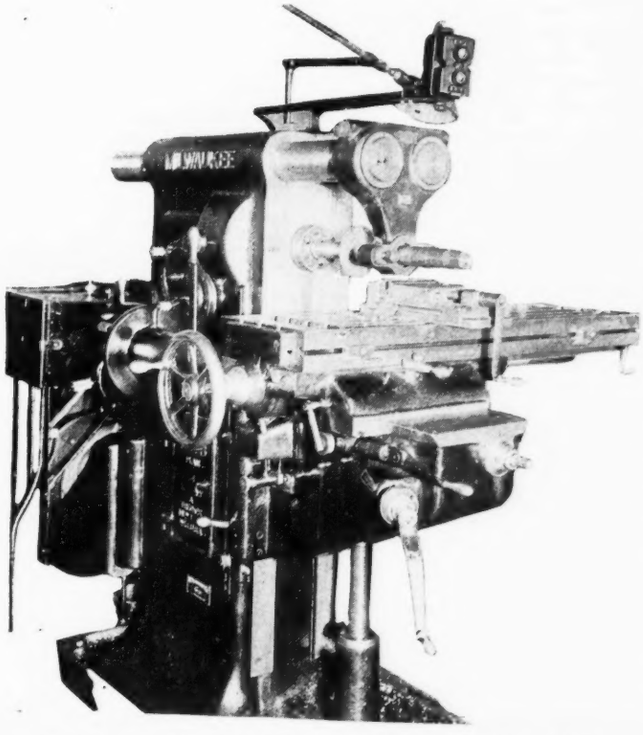


Fig. 3. Button control assembly on bracket above overarm. Controller and motor behind machine

Study of the controller situation brings out some interesting facts about the prevailing power requirements and habits of the industry generally. Outside of the Ford Motor Co., which produces its own direct current, and a few isolated cases, alternating current is the rule. Also, few concerns attempt the generation of their entire electric power requirements. On the whole, the tendency is toward greater dependence upon public service corporations for power requirements and many of the newer plants have reduced the power house to a mere heating plant.

These tendencies are closely related and result from the greater facility with which alternating current can be delivered commercially. Where direct current is required for special purposes such as storage battery boosting, electroplating, dynamometers, cranes, hoists and lifting magnets, or for machines requiring almost infinite variability of speed, rotary converters are becoming almost the rule. Most of the direct current installations, particularly where they are related to the drive of mechanical equipment, are made to suit demands of speed variation, etc., which are impossible with the use of alternating current. Due to their special nature, each of these is largely the subject of individual engineering study and the results can not be treated in a general way. However one or two

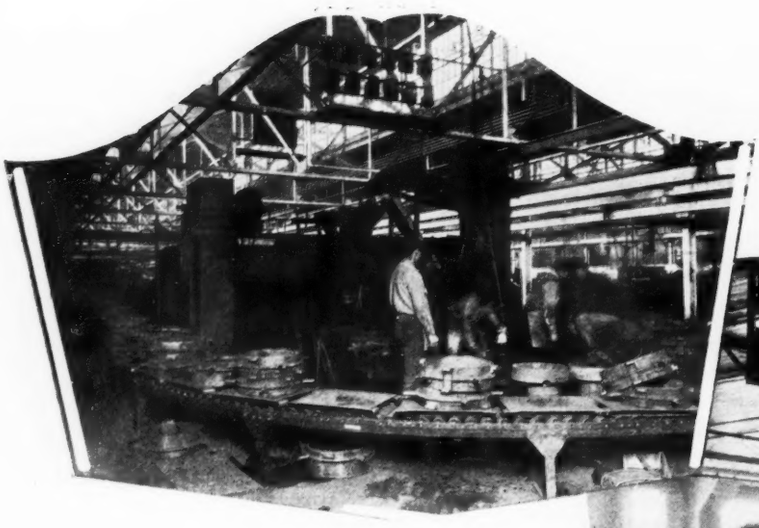


Fig. 4. Controllers and safety knife switches assembled on roof truss. Button controls and motors placed at most advantageous points around continuous molding line

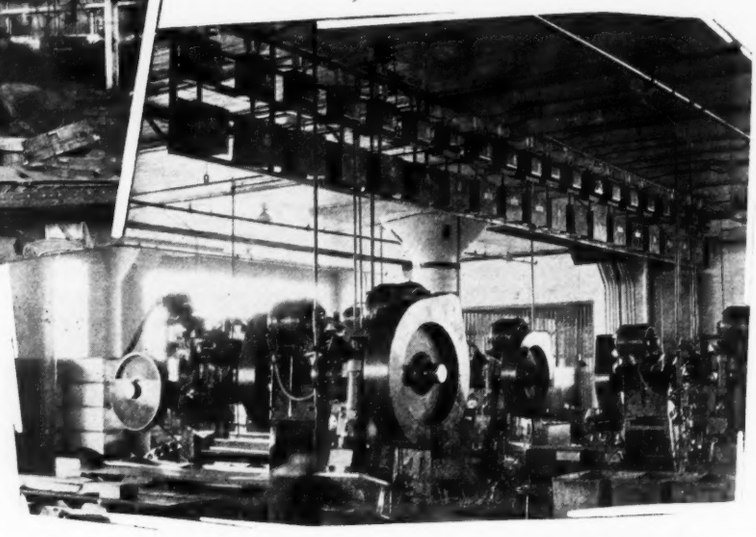


Fig. 5. In press room twenty controllers and knife switches suspended from ceiling handle all presses. No floor space is required and operators can reach only the button switches

unusual installations will be discussed later in this article.

Another factor in the consideration of automotive electric power and its control is that from 85 to 90 per cent of the motors now in use are 15 hp. or less. Practically all of the standard machine tools are driven by the motors in this class with the exception of the large cyclic type machines, continuous millers, etc., where many tools are in simultaneous operation.

The bulk of the remaining motors are of 60 hp. or less capacity, although a large number of 150 hp. motors are in general use in conjunction with large presses for body panels, fenders, etc. Then there are a few motors of high horsepower output. For example, one of these is a 600 hp. synchronous motor for air compressor drive where central storage is used.

Across-the-Line Switches

With the acceptance of electric control in the present broad way, still another tendency is noted in automotive plants. This tendency is a direct product of the type of control which eliminates the probable defective judgment of the operator and substitutes automatic control. In several plants, across-the-line switches are installed for use in starting motors of as high as 60 hp. output. This practice differentiates from the conventional idea that motors of 15 hp. and greater should be equipped with compensators in conjunction with the starting switch. Many plants within the industry still use compensators on all motors from 5 hp. up and a few others make the distinction between across-the-line switches and compensators at 7.5 hp.

It should be explained that the across-the-line switch does what its name implies by closing all three leads of an alternating current line simultaneously and delivers full line voltage to the motor, while with the ordinary compensator either resistance or transformer effect is introduced to decrease the current delivered to the motor until that unit is brought up to speed. When a motor is started, the rate of current flow or amperage increases to 5 to 7 times that required for running conditions and tends to overload all of the elements involved in the system. The purpose of the compensator is to eliminate this peak condition by substituting two peaks of approximately half the magnitude.

Plant engineers who are installing across-the-line switches for the larger motors argue from the following angle. With the safety provisions in the way of thermal or solenoid overload devices which are incorporated in practically all modern starters, the crux of the problem is the power factor as related to the high amperage when motors are started. The greatest load on the line is imposed when starting operations in the morning, at the beginning of a shift or after lunch. Then when the adequate transformer capacity or most modern industrial plants is considered, there is not much difference between 1000 high peaks or 2000 peaks of half the magnitude which will occur in a plant where 1000 motors are started in a few minutes' time. However, it must be remembered, that this viewpoint is based on the fact that the overload devices which are installed in both modern across-the-line switches and compensators are very accurate and determine the time limit of overload on a motor to almost a fraction of a second and then open the line when the overload becomes dangerous to either motor or transformer.

In conjunction with this point it is interesting to note that the Detroit Edison Co., which supplies commercial electric power to the center of the automotive industry, recently has raised the limit for across-the-line switches in isolated installations. Formerly the small shop was compelled to install compensators with all motors of 5 hp. or greater. Recently the limit has been raised to 15 hp. Usually these small shops have no transformers, whereas the automotive as well as other industries has learned the value of liberal transformer capacity.

Due to the broad use of alternating current and the increasing use of across-the-line switches for motors of larger capacity, the problem of machine tool drive and control is generalizing very rapidly to the consideration of control buttons in conjunction with across-the-line switches. A few illustrations of typical installations of the various makes of switches on different machine tools will illustrate the trend of current practice to the best

advantage. These will be followed by illustrations of compensator installations and some special direct current applications.

Fig. 1 shows the circuit of a typical button starter for the common three phase circuit. While this particular diagram may depart in some details from those of other manufacture, it is fairly representative of the principles involved. At *A* is located a 3-point contact switch which closes the main circuit as it is thrown in by the magnet *B* in the maintainer circuit, which is tapped off of the main circuit ahead of the switch. The maintainer circuit is formed by closing the "start" button and then remains closed due to a tap which rejoins one member of the 3-point contact main switch. Operation of the motor continues until the "stop" button is pressed to open the maintainer circuit or until the voltage falls off so that the magnet is no longer able to hold the switch in place. The latter feature is known as no voltage or low voltage control. The circuits for three types of button control are obvious.

At *C* are two overload control switches of either solenoid or thermal type. It will be noted that these are placed in but two leads of the main circuit, but as these are located possibility of single phase operation of the motor is prevented. With ordinary fuses it is possible for a motor to continue in single phase to operate under overload after one fuse has blown out and the result usually is considerable damage. Practically every modern type of overload relay incorporates adjustments which permit adjustment of overload capacity and duration to very close limits. This feature accounts very largely for the fact that capacity of motors installed in conjunction with modern control facilities can be held more nearly to the actual normal requirements. Temporary overloads of less than destructive magnitude can be handled by the overload relays or thermal devices without breaking the circuit.

Fig. 2 shows the simplest form of button control applied to a punch press. This is an Industrial Controller Co. installation with the buttons incorporated in the metal housing which is fastened to the left side of the punch frame. The controller box assembly is out of sight, being attached to the back of the frame and out of the way, while the motor is installed near the top of the press. This arrangement with a "start" button and a "stop" button is used to the largest extent.

In Fig. 3, a Westinghouse two-button switch is carried

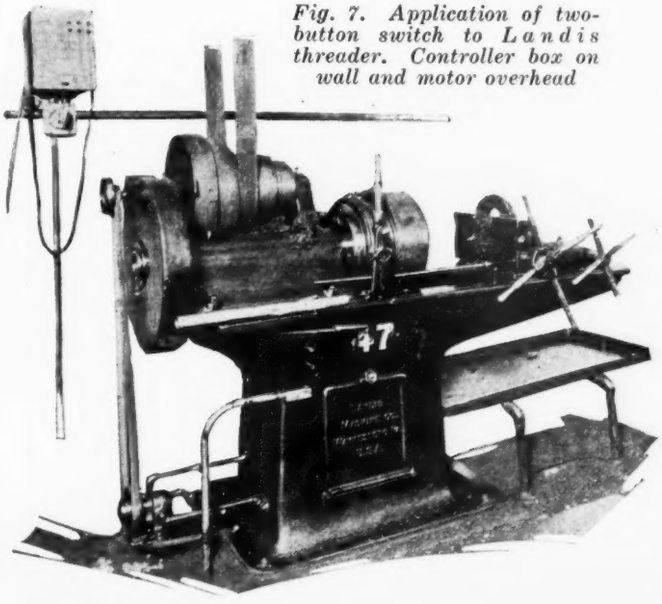


Fig. 7. Application of two-button switch to Landis threader. Controller box on wall and motor overhead

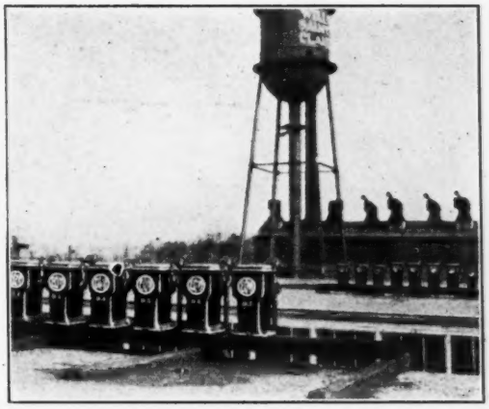


Fig. 6. Fourteen compensators are located on roof of Wills Ste. Claire plant. No floor space within shop is taken up and tampering by unskilled employes is impossible

on a bracket above the overarm of a milling machine while the control box and motor are placed behind the machine.

One of the outstanding features of modern electric control is demonstrated by Fig. 4, which shows a continuous molding floor in the foundry of the Wilson Foundry and Machine Co. Although only the Allen Bradley control boxes and line switches are shown clearly in the upper part of the view, six motors, which are the entire power equipment of this continuous operation, are located at various points and manual control in the form of two button switches is carried to various convenient points around the gravity conveyor.

Up to date controller practice is in the direction of placing the controllers and accompanying knife switches and fuses up under the roof space or in some cases on top of the roof. The line switches are required by regulations in practically every community and are used for protective purposes during periods of repair. Fig. 5 shows an installation of 20 Monitor controllers in a press room while Fig. 6 shows 14 Electric Controller and Manufacturing Co. compensators on the roof of the Wills Ste. Claire plant.

Another typical two-button installation is shown in Fig. 7 where a two-button Cutler Hammer switch is placed on a Landis thread cutter with the control box on the wall and the motor overhead.

From the standpoint of the operator, the button control switch is about the same for a three phase across-the-line switch as for the most complicated control. As the complexity of the motor function increases, one or two buttons or occasionally more are added, but each serves a specific purpose without any chance of confusion or uncertainty of results. It is possible to combine the control of direction of the rotation of the motor with dynamic braking and a closely set rate of acceleration and limit operation in one simple control button box.

Practically all manufacturers of controller equipment build a variety of button switch or relay assemblies which parallel the variety and flexibility of electric circuits. Some of these assemblies incorporate as many as a half dozen buttons, although most of these are placed in installations where the operator's judgment is above the normal average. Usually the number of buttons is limited, although the functions and mechanical adaptations of the electric circuit may be most elaborate.

Application of button control to gear box testing is shown in Figs. 8 and 9. The first shows the interior of the sound-proof booth with the various buttons aligned along the wall and with a gearbox in place. This unit is driven by a motor outside of the booth as shown in Fig. 9, which also shows the location of the Monitor automatic controllers which are subject to the push buttons within the booth. In order to complete the scope of the gear box test at various speeds and in both directions, the row of

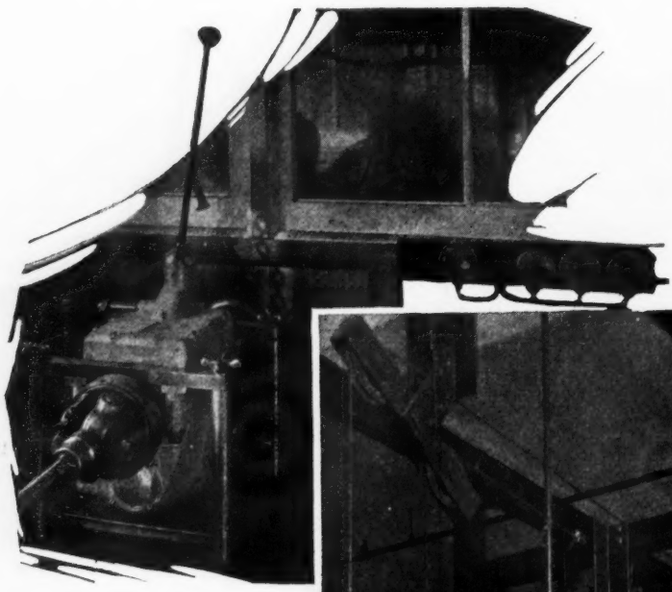


Fig. 8. Interior of gearbox testing silent booth. Control buttons on wall supply complete control

push buttons supplies the following control. One set of push buttons is used to start, stop and reverse the motor used for driving purposes while another push button station is provided to control the small motor mounted on top of the main motor and used to shift the armature of the larger motor.

With button control is associated the idea of remote control, which in fact has characterized practically all of the illustrations shown herewith. Fig. 4, showing the continuous molding floor at the Wilson foundry, is a particularily striking illustration of the idea. Another illustration where remote or button switches control a moving unit is shown by Fig. 10, where a box carrying "up," "down" and "start" buttons controls a traveling electric hoist for handling passenger car bodies. The simplicity of this control from the operator's standpoint is obvious, but the following is the story from the standpoint of the control manufacturer:

The push button station is located in the center of the pipe railing in the foreground. Pressing the proper button will cause the hoist to move upward or downward or to stop. The operator is not concerned about cutting out the starting resistance too quickly. Monitor interlocked acceleration relays bring the motor up to speed quickly and safely. Pressing the stop button automatically disconnects the motor from the line and applies the dynamic brake. Similarly, if the direction of travel is reversed, the dynamic brake is applied automatically, the motor stopped and then started in the opposite direction. At the upper and lower limits of travel, hatch limit switches connected to the controller automatically disconnect the motor from the line, apply the brake and bring the hoist to a stop at the proper level.

When these features, which are common

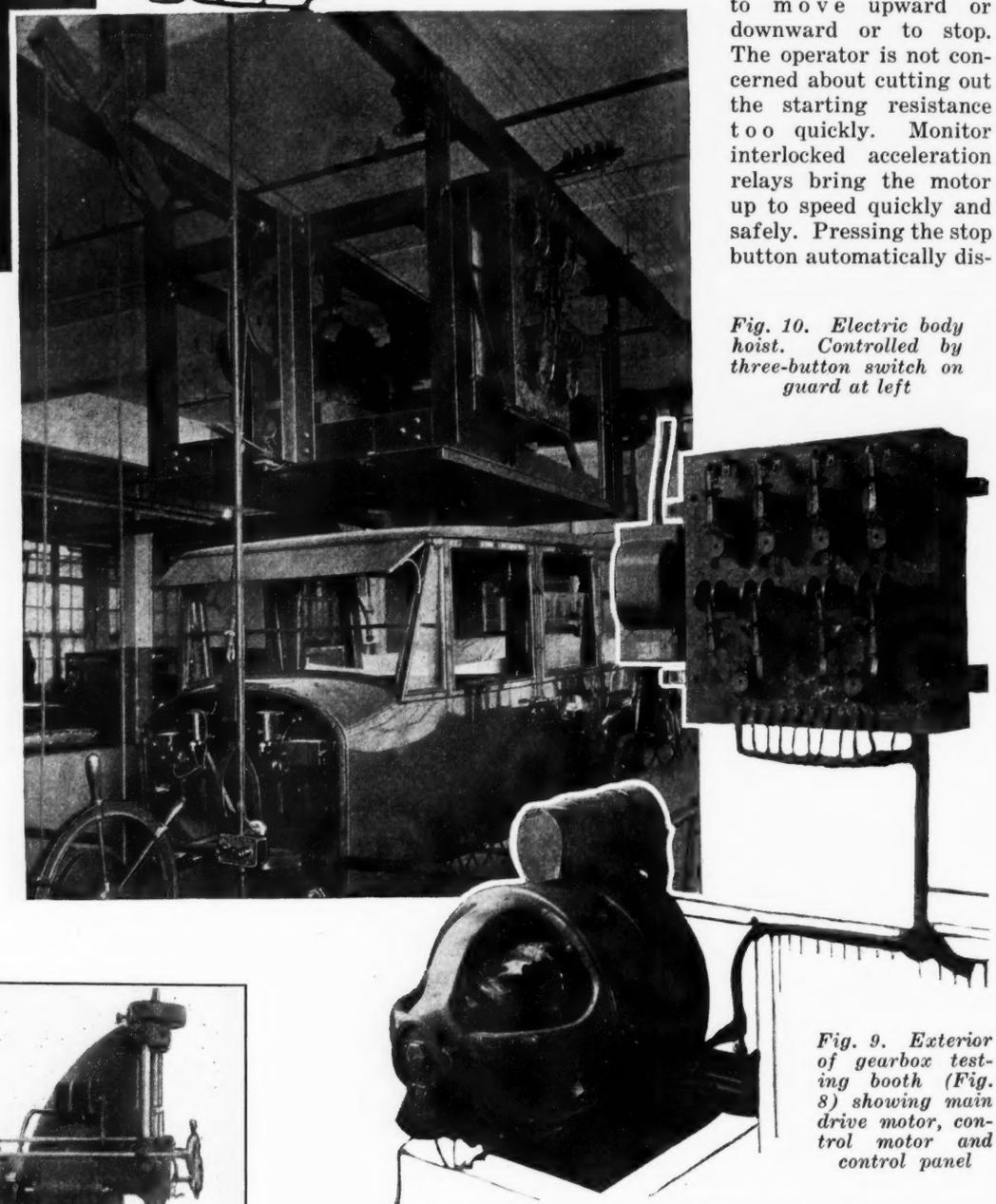


Fig. 10. Electric body hoist. Controlled by three-button switch on guard at left

Fig. 9. Exterior of gearbox testing booth (Fig. 8) showing main drive motor, control motor and control panel

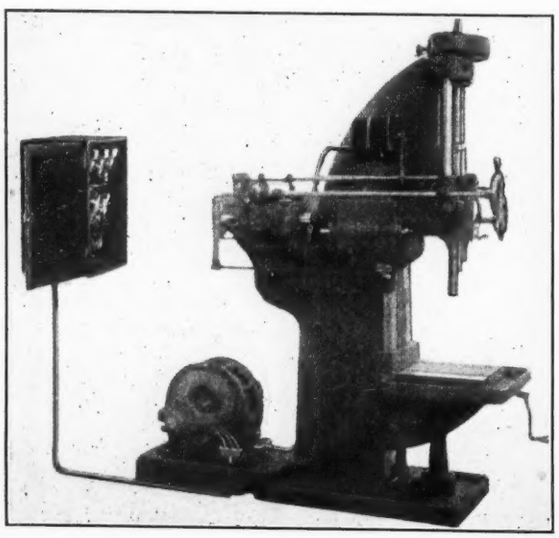


Fig. 11. Tapping machine in which reversing is accomplished by control of slip ring induction motor

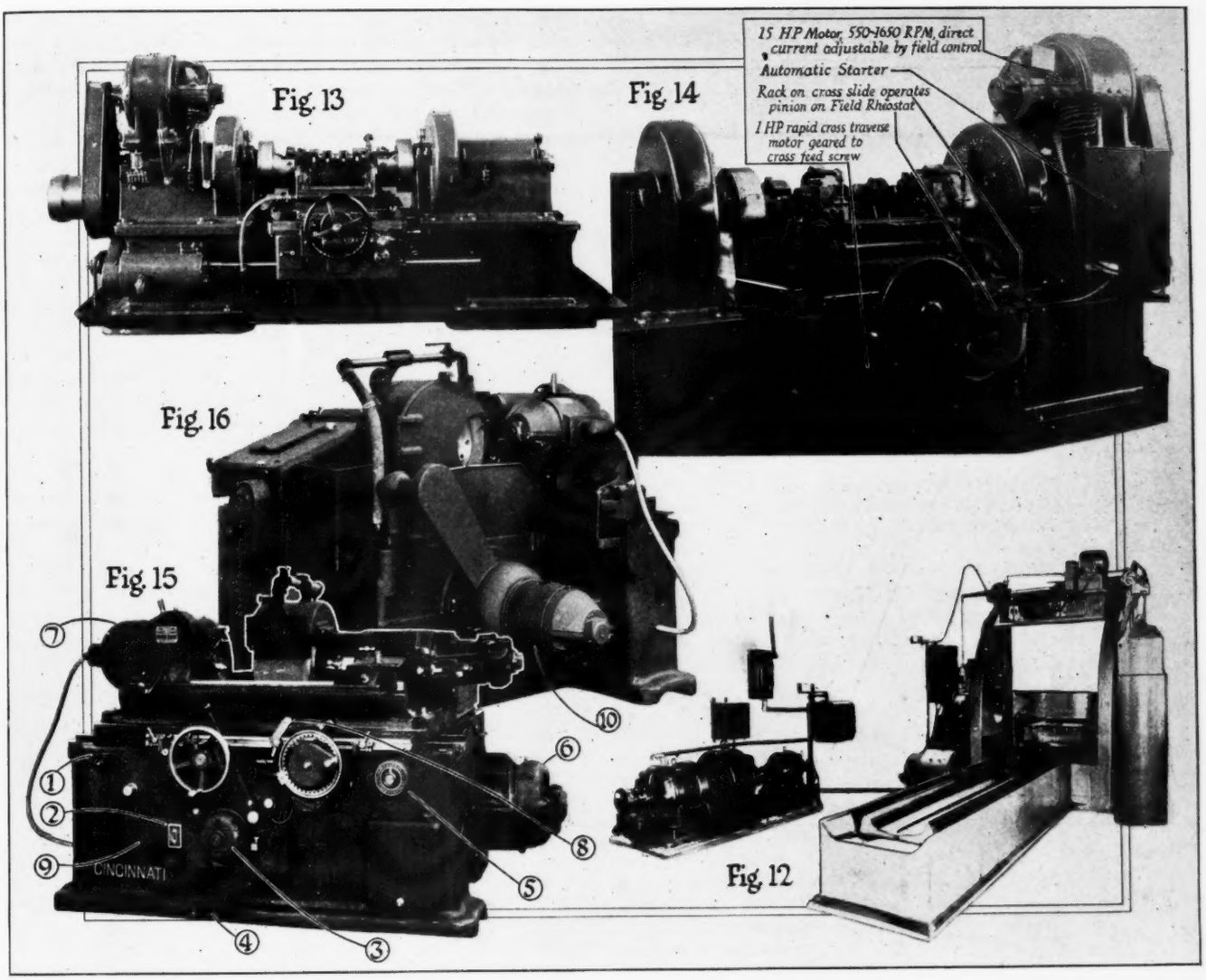


Fig. 12. Rotary converter used to deliver direct current to motors and controllers for all functions in heavy duty planer. Fig. 13. Wickes Brothers crankshaft lathe showing direct current drive motor with start and stop button control on headstock. Auxiliary controller for rapid traverse of cross slide mounted on apron. Fig. 14. Field rheostat varying r.p.m. of main drive motor controlled from cross slide. Also showing automatic controller for main drive and mounting of small motor for rapid traverse of cross slide. Fig. 15. Front of Cincinnati Plunge Cut grinder indicating various features of electric drive and control system. Fig. 16. Back of same machine showing additional features of electric system

practice among electric control men, are added to others, such as safety for men, buildings and equipment, protection against overload or low voltage, and greater economy of operation, the reasons for the rapidly growing adoption of full electric control in the automotive industry are obvious.

High Speed Tapping

High speed tapping has been solved fairly well from the standpoint of the machine tool builder and the automotive plant engineer but on the whole has resulted in mechanism which requires considerable maintenance work when the machine is in the hands of the average operator. With electric control it is possible to utilize simple drilling machines for this work and the drive can be an alternating current motor. Fig. 11 illustrates a heavy-duty drill press equipped for tapping service. The regular controller which takes care of starting and stopping is shown on the wall at the rear. Reverse is accomplished by the use of a slip ring induction motor and the use of a special reversing control which is installed at the side of the column and connected by a link chain to the quill operating mechanism. This installation was made by the Cutler Hammer Mfg. Co.

A typical rotary converter installation is shown in Fig. 12 in which a planer is equipped with electric drive for its various functions. Alternating current drives a 35 hp. motor which in turn drives a direct current generator and exciter. Cross and vertical feeds are operated by small motors while the bed is driven by a larger direct current motor. Controllers within easy reach of the operator are used to regulate the speed of the various components as well as the change of direction.

That machine tool builders have not failed to recognize the value of electric power combined with modern methods of control is shown by some of the developments in this field during the last two years. Probably the most recent development in this direction is the new crankshaft lathe made by Wickes Brothers of Saginaw, Mich. As shown by Fig. 13, a double-end drive crankshaft turning lathe is equipped with a 15 or 20 hp. motor which rotates the main spindle drive mechanism through a silent chain. As

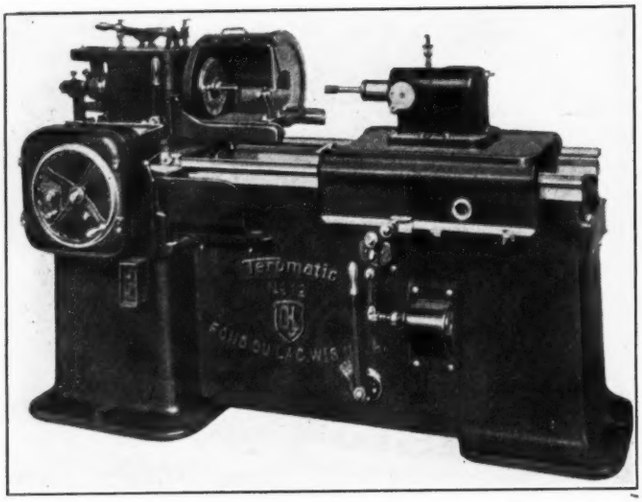


Fig. 17. Teromatic Grinder which incorporates the electric motors in unit assemblies and rough and finish sizing are electrically controlled

this lathe is designed to turn crankshaft speeds, the problem of the reduction in cutting speed due to working at smaller diameters as the center of rotation is approached was encountered and solved by the adoption of electric control.

Where crankpins only are to be turned, the manufacturer recommends a 15 hp. constant speed motor of 1200 r.p.m., but in the turning of cheeks, the full advantage of the machine's rugged construction can be taken by the use of a variable speed motor with an approximate range of 550 to 1650 r.p.m. In this case a direct current main drive motor is used with a field rheostat interconnected with the cross slide mechanism as shown in Fig. 14. A small rack on the back of the cross slide engages with a gear which is mounted on the rotating shaft of the rheostat in such a way that the speed of the main drive motor is increased as the tools approach the center of rotation. Consequently, the r.p.m. of the shaft in operation is increased and the peripheral speed at the tools is held practically constant at the best figure for economy of tools and high production.

Fig. 14 also shows the mounting of a 1 hp. motor on the carriage for the purpose of obtaining rapid traverse of the tools. This motor is enclosed in a sheet steel box below the projecting cross slide assembly and drives the cross slide screw through spur gears, the cast enclosure being shown in the foreground. A controller for this motor is mounted on the apron and is used to bring the tools up rapidly to the cutting position after a crankshaft is placed in the pot chucks. At the conclusion of the cheek facing operation, after a few revolutions of the spindle have been made at constant diameter to insure sizing, this motor again comes into play automatically and by reversing the feed screw, runs the tools out rapidly to the unloading position and stops at that point.

Incidentally, electric control men cite one big advantage which accrues to Ford's use of direct current. That is that the speed of any operation can be regulated exactly by the mere installation of a field rheostat in conjunction with the driving motor. In this way the usual juggling of pulleys, change gears or sprockets which accompanies a change of speed with a constant speed motor is eliminated and experiment to determine the best speed of operation is facilitated.

Another outstanding exponent of electric drive and control is the Plunge Cut grinder made by the Cincinnati Milling Machine Co. In this machine, which incorporates three electric motors and their control, all changes of feed, etc., are made electrically. No belts are shifted at any time. In fact, only two belts are found in the entire machine, one between the main driving motor and the grinding wheel spindle and the other driving the coolant pump. The elaborate scope of the electrical application is shown best by Fig. 15 (see preceding page), and its reference figures:

1. This lever determines the rate of cross feed for the table. It controls cross feed motor 3 which runs from 900 to 2700 r.p.m. and produces a range of 34 feeds varying from .012 in. to .108 in.
2. Starting switch for cross feed motor 3.
3. Cross feed motor, or, as it is styled with this machine, the infeed motor.
4. This treadle operates a push buttom switch within the bed of the machine which in turn starts or stops the headstock drive motor 7.
5. This rheostat controls the speed of rotation of the work by varying the r.p.m. of motor 7.
6. Main driving motor which drives the headstock. A 20 hp. motor which when necessary for the production of direct current for the variable speed motors, drives the generator shown at 10 in Fig. 16.
7. The headstock driving motor which drives the headstock through a chain and worm gear combination.

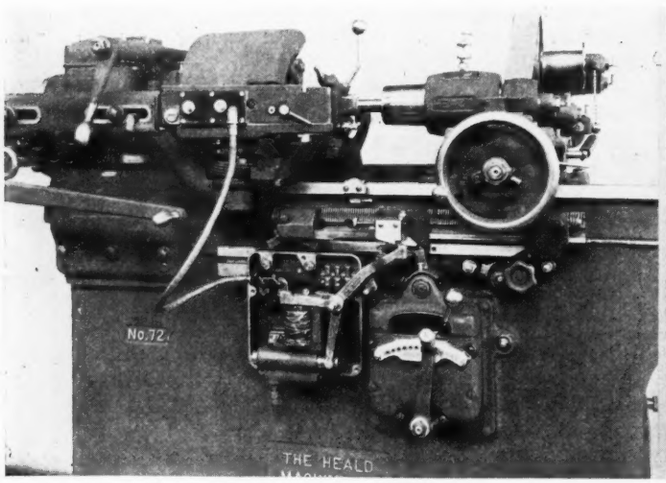


Fig. 18. Heald Full Automatic Grinder which has magnetic control for sizing, wheel dressing and completing cyclic operation

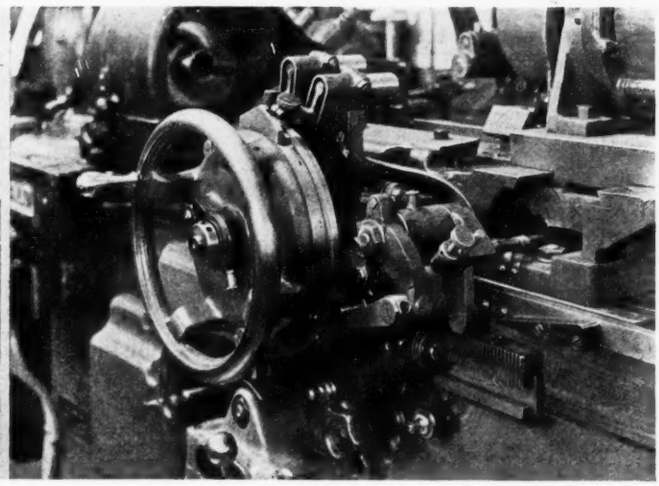


Fig. 19. Heald Sizematic Grinder showing cam and lugs which operate magnetic circuits for sizing and wheel dressing

8. A short circuit control arm which when brought into contact with the sizing stop shorts out the cross feed motor and stops the cross feed electrically and automatically.

9. Fuse box for switch 2.

10. Direct current generator which is used in some installations.

Of the automotive machine tool suppliers, grinder manufacturers seem to have grasped the possibilities of electrical power and control to the greatest extent. Gardner and Blanchard are examples of the application of motors directly to wheel spindles. Still another field is opened up by the utilization of electric sizing devices which are used by both Giddings and Lewis Machine Tool Co. and The Heald Machine Co. In the Teromatic grinder made by the former concern, three electric motors are inherent units of the machine's construction. One motor of 1 hp. is a part of the headstock assembly and drives the spindle through a train of change gears. Like all of the motors involved in this machine, either direct or alternating current can be used for the drive. This motor also drives the feeding mechanism which moves the head laterally in relation to the grinding wheel.

Motor on Saddle Assembly

A second motor is mounted on the saddle assembly which incorporates the grinding wheel spindle and drives that member at speeds as high as 20,000 r.p.m. through an intermediate endless fabric belt. The entire wheel head assembly, including this motor, is moved back and forth at a very high rate of oscillation by a hydraulic ram, but the action is very smooth due to the absence of mechanical connection which characterizes the usual train of gears and shafts. This motor will deliver 2 to 3 hp. in continuous service. A third motor of 1 hp. capacity drives the coolant pump and the high pressure oil pump which supplies the hydraulic ram.

In addition to the two-button switch on the front of the bed which controls the general operation of the machine, a system of sizing plugs and relays produces cyclic operation with relation to the progress of each individual piece. As shown in Fig. 17, at the extreme left and concentric with the headstock center, a bracket carries a shaft which rotates with the work spindle. At the inner end of this shaft are two plugs which tend to enter the hole, being ground at each outstroke of the grinder head. The first of these plugs is the rough sizing plug. When the machine is put into operation on a piece, material is hogged out of the hole at a high rate until the smaller or sizing plug just enters. With this action a system of relays in an electric circuit reduces the rate of feed to produce a finishing cut until the larger or finished size plug just enters the hole. Simultaneously another system of electric relays runs the grinder head back on the ways to a position which facilitates unloading, turns off the coolant supply and stops the machine. In spite of what seems to be an apparent complexity of functions, the combination of electric control with hydraulic drive has reduced the design of the machine to a few relatively simple sub-assemblies, each of which is self-contained.

In the Heald grinders, the Full Automatic and the Sizematic, which were described in *Automotive Industries* of Sept. 3, 1925, and Mar. 4, 1926, respectively, magnetic circuits are utilized to control the sizing of work. Fig. 18 shows the front of the Full Automatic grinder with magnet container open. Actuation of the magnetic control system is by a diamond pointed finger which runs in the hole to be ground at all times. As the work approaches size, this finger closes the electromagnetic circuit which lifts a latch which backs the wheel head out to bring the wheel in contact with a diamond dresser. Simultaneously the diamond is brought into the proper position and is retracted at the end of the dressing operation. Then the wheel returns to the work at the most desirable rate of feed and continues until the correct size has been obtained. At this point the sizing finger closes a second contact and the circuit through a second magnet immediately behind the one shown. This magnet releases the mechanism which withdraws the grinder head to the unloading position.

In the Sizematic grinder, the control finger has been eliminated and the control for the magnetic system is transferred to an adjustable cam bearing ring which augments the usual handwheel for determining work size. The same provisions for withdrawing and dressing the wheel are retained but sizing is accomplished by dressing the wheel so as to produce a standard size hole for each cycle of operation. The cam with its contacting dogs is shown in Fig. 19.

When the combined efforts of the builder of electric motors and controllers, the machine tool designer and the automotive plant engineer are considered in the light of their results up to date, it is safe to predict that within a relatively brief period the drive belt and countershaft and their troublesome relatives will go into the automotive category of white elephants. Even the elimination of the lowly belt guard will warrant this procedure. Square inches of floor space are beginning to count in many plants when new layouts are considered.

In the machine tool field, the broader use of modern electric control will produce simpler instead of more complicated constructions. Much of the complexity of present tools is just the result of attempting to hitch one motion on to another. A great portion of this elaboration can be eliminated by throwing out a lot of gears, shafts, bearings and the various monkey motions and their housings and substituting an electric unit which is coordinated with the balance of the machine by one of the rapidly advancing controller developments. A sample is shown by a three motored Natco horizontal drill which was illustrated in the description of the Ajax rear axle line in *Automotive Industries* of April 22, 1926.

Just as electric power and modern control have cleaned up the progressive shops of today, so will the adoption of the same features clean up some of the time-worn machine tool troubles. Power operated material handling equipment falls within the same classification. It is just the old experience of utilizing a development which departs somewhat from the beaten path of our ancestors. For a while we use the different thing sparingly, somewhat fearful of its expense. Suddenly we awake to the realization that its very use has brought the price down to almost less than a reasonable figure and a new order has developed.

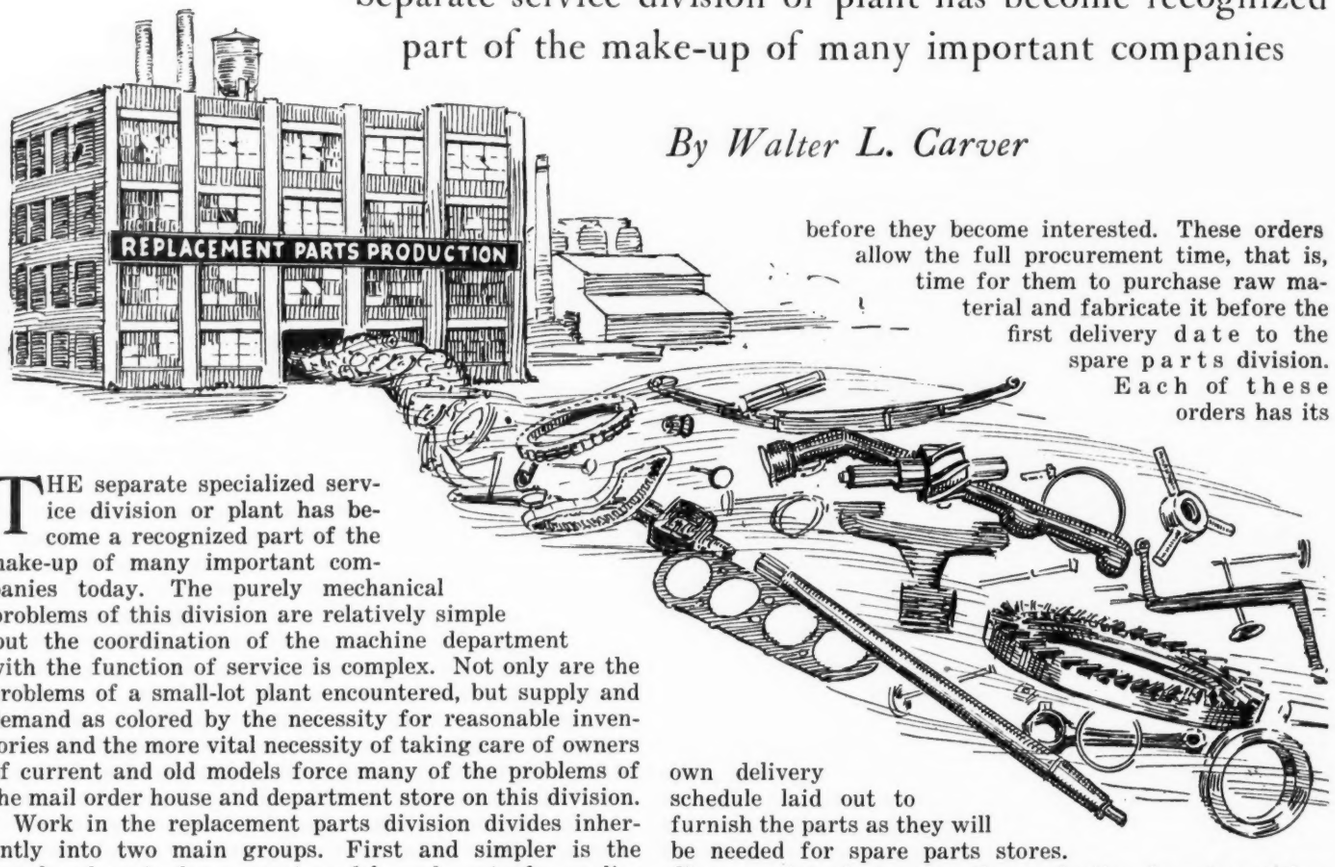
IN order to secure a high degree of turbulence and consequent good distribution of the fuel in an oil engine, a British inventor provides two cylinders arranged V-fashion at a relatively small angle.

The two pistons work on the same crankpin, the compression space in one cylinder is made much greater than that in the other and the two compression spaces are connected by a passage of venturi form, at the throat of which the injector nozzle is located. Toward the end of the compression stroke, when the fuel is being injected, there is naturally a strong rush of air from the smaller to the larger compression chamber, and this is claimed to ensure effective distribution of the fuel throughout the charge.

How the Factories Are Meeting of *Replacement Parts*

Separate service division or plant has become recognized part of the make-up of many important companies

By Walter L. Carver



THE separate specialized service division or plant has become a recognized part of the make-up of many important companies today. The purely mechanical problems of this division are relatively simple but the coordination of the machine department with the function of service is complex. Not only are the problems of a small-lot plant encountered, but supply and demand as colored by the necessity for reasonable inventories and the more vital necessity of taking care of owners of current and old models force many of the problems of the mail order house and department store on this division.

Work in the replacement parts division divides inherently into two main groups. First and simpler is the supply of parts for current models and parts for earlier models which are interchangeable with current production. Second and highly complex in its handling is the supply of parts for obsolete models.

Replacement parts fall into three natural divisions: First, parts procured from the regular production department; second, parts purchased complete from outside sources, including parts which were purchased from outside sources for the original production of the cars; third, parts which must be made in the replacement parts production department.

In view of this classification it is obvious that the supply of current service parts is withdrawn from the regular production department. For parts produced within the plant, requisitions are placed directly upon the shop. For general service work, the amount is based usually upon an estimate of three months' requirement. Generally, the total amount is prorated into monthly deliveries.

Practice in this respect is illustrated best by excerpts from statements of various service managers. E. Roberts of the Franklin Automobile Co. states: "The production department makes no plans of its own accord for the manufacture of replacement parts. It is necessary for the spare parts department to place a procurement order with them before they become interested. These orders allow the full procurement time, that is, time for them to purchase raw material and fabricate it before the first delivery date to the spare parts division. Each of these orders has its own delivery schedule laid out to furnish the parts as they will be needed for spare parts stores. Upon receipt of an order, the production department then plans for the amount ordered over and above the requirements for the car schedule. These parts are routed through the shop in conjunction with the regular orders and the material is delivered to spare parts stores according to the schedule previously laid down."

Chrysler policy is described thusly: "The production of current model parts is run concurrently with regular production schedules based on 90 day's estimate furnished and revised monthly by the Service Division. In case of stock stringency service requirements are given priority."

Another manufacturer states: "The method we use in scheduling parts on current models is to notify our production and purchasing departments as to what our requirements will be for a certain length of time so that these pieces can be included in the regular production schedule.

In some concerns, among which are certain of the General Motors units, the elaborate system of production records has been displaced by the physical or visual inventory system. Parts are not stored to any extent in a storeroom proper but are delivered to the point of application. However, at any of these points, a bank or reserve supply of predetermined amount is held. When the number

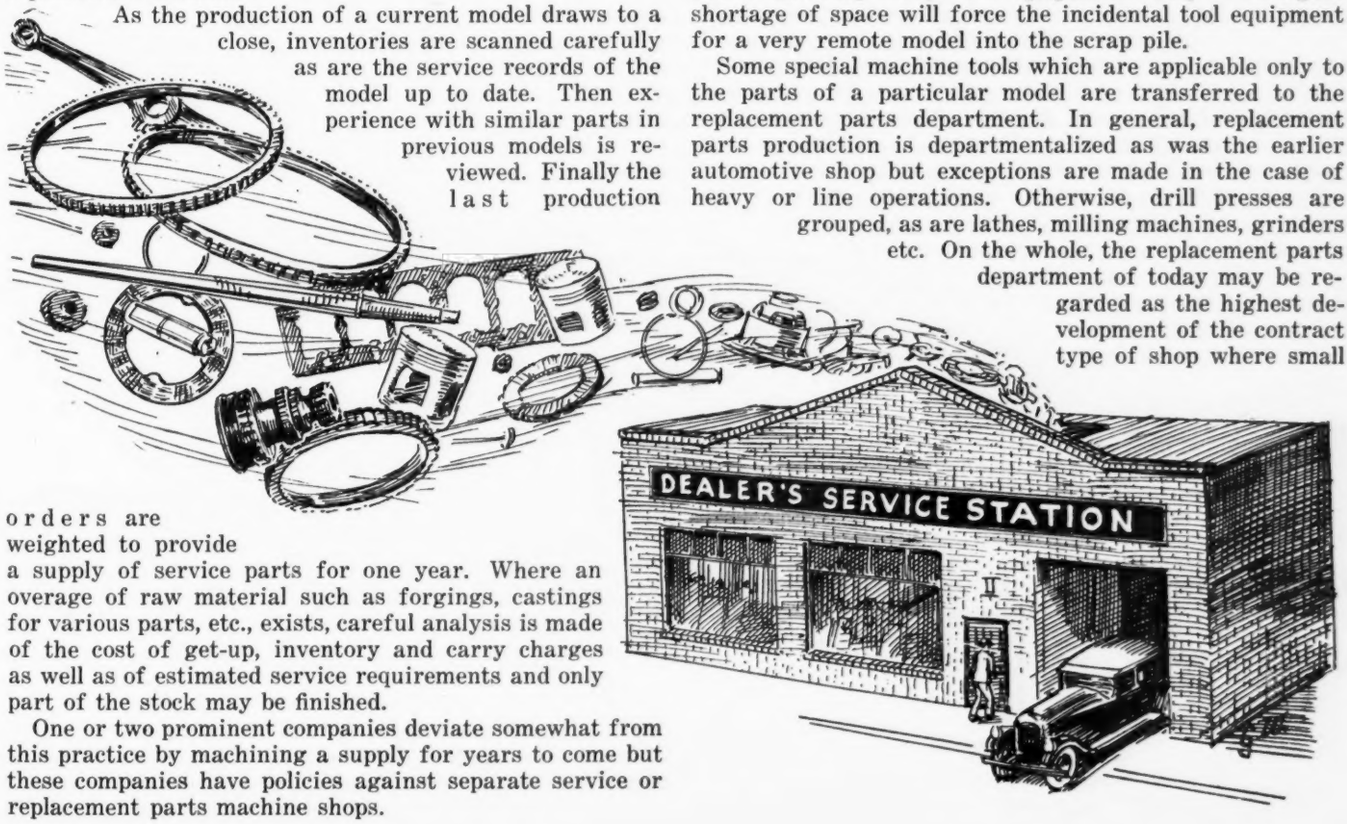
the *Complex* Problems Production and Distribution

of parts falls below the reserve number, an impending shortage is reported by the operator at that point. If the amount is obviously in excess of the reserve supply plus current requirements, service stock is supplied immediately upon scheduled order. Production orders are weighted originally to incorporate scrap loss and estimated service requirements so that on the whole the system works out that monthly service requirements for at least 85 per cent of all parts are available immediately.

From the replacement angle, parts purchased from the outside are on about the same basis with most concerns as parts made within the plant. Instead of the production department, the purchasing department is the source of supply and current production orders are weighted accordingly. This type of parts includes lamps, instruments, etc., which are purchased from outside sources for original use.

No mention has been made thus far of the methods of determining the amount of service stock or the method of accounting as these two details fit into the more complex structure of the production and management of replacement parts for obsolete models.

When a model leaves the current and joins the obsolete class, the need for real management of the replacement parts and service division becomes a necessity. The trend of best practice at this stage can be discussed to the best advantage by following the process from the production to replacement division.



As the production of a current model draws to a close, inventories are scanned carefully as are the service records of the model up to date. Then experience with similar parts in previous models is reviewed. Finally the last production orders are weighted to provide a supply of service parts for one year. Where an overage of raw material such as forgings, castings for various parts, etc., exists, careful analysis is made of the cost of get-up, inventory and carry charges as well as of estimated service requirements and only part of the stock may be finished.

One or two prominent companies deviate somewhat from this practice by machining a supply for years to come but these companies have policies against separate service or replacement parts machine shops.

Inventories of finished material furnished by outside sources also are scrutinized. If the surplus is greater than a liberal estimate of service requirements over a few years and the parts such as headlamps, etc., are not suitable for other models, the amount over and above the estimated is sold at the best price. This phase of the replacement parts scheme resembles the bargain sales of department stores in which slow moving material is priced to attract purchasers. While the parts are valuable and can be carried as assets at current market value, the question of space is the real determinant of the volume which can be carried. Perhaps no other industry sets as high value on shop space as the automotive. Square feet of inactive floor space constitute an anchor on turnover and the largest possible profit on fixed investment.

Then all tools, dies, jigs, patterns, etc., for obsolete parts are transferred to the replacement parts department. Here again, space rather than inventory charge is the important item. The scrap or salvage value of incidental production equipment is small compared to its original value, which is chiefly labor. Due to profits out of production with these tools, a great share of the original cost has been absorbed. But the chief value is the element of protection for old models. While policies vary somewhat, most concerns attempt to protect old models for periods of at least ten or twelve years. Even then, most service divisions are chary about throwing away tool equipment. Only a stringent shortage of space will force the incidental tool equipment for a very remote model into the scrap pile.

Some special machine tools which are applicable only to the parts of a particular model are transferred to the replacement parts department. In general, replacement parts production is departmentalized as was the earlier automotive shop but exceptions are made in the case of heavy or line operations. Otherwise, drill presses are grouped, as are lathes, milling machines, grinders etc. On the whole, the replacement parts department of today may be regarded as the highest development of the contract type of shop where small

lots of miscellaneous work are handled on short order.

Modern production methods have complicated the tooling problem of the replacement parts divisions. As a typical example, a monobloc cylinder casting in regular production is passed over highly specialized rotary mills, drill presses incorporating two, three or four multiple spindle heads, and multiple spindle boring equipment. Obviously it is impossible to transfer equipment of this type to the replacement division. Furthermore, the jig and fixture equipment incidental to these machines is highly specialized and in many cases is not applicable to standard machine tools which form the bulk of the equipment of the replacement division. Therefore it is necessary in many cases to design and build new fixtures, etc., for this division. Some companies attempt to offset this necessity by running out rather large quantities of these parts at the end of the last production run and offset the inventory charge by the elimination of the tooling cost.

Estimating Production

With the statement that the replacement parts shop represents the highest development of the short order contract shop, the mechanical equipment and methods are described adequately for many of these divisions. The same idea is a good idea for others who are not so advanced to shoot at. But the management of this equipment, particularly with relation to the important question of how many to make and when to make them, is quite another problem which is grafted on the contract shop but also is a vital portion of the responsibility of the executive.

This problem divides itself into two major elements with a third, enterprising shop management, attached. The first element is what to put into the shop and in what quantities, while the second is how to get parts out of the shop and on their way to anxious customers in the shortest possible time. Practically every service manager who appreciates the importance of each of these elements will state that the stock card is the foundation of the whole scheme. The replacement parts stock card is an inventory record, a fellow-up record, and, of still greater importance to the successful operation of the division from both financial and good will angles, is a history. In this respect it resembles more than anything else the history which specialists make of a patient in a hospital.

"What to order and in what quantities" is the problem which has kept a lot of service managers tossing on their pillows. The buying taste of ladies is no more temperamental and ephemeral than the demand for some replacement parts. For a model which has but recently been turned over to the replacement parts division, a demand for one part may exceed productive ability for a year or so and then collapse completely. Apparently everybody interested has filled his demand and that is the end of the chapter. It may be years before another order for the same part is received.

The stock card alone is not the solution of this situation, but can be used as one factor. It should be remembered that the stock card begins as a record of performance or history when the service department begins to function on a new model. Until the transfer of equipment, the service department acts as an agent, but in this period the stock card begins its career. It is during this time and immediately following the transfer that unusually troublesome parts pass through the department in addition to the regular run of replacement parts. After the transfer, the service department becomes the manufacturer and sales department for these parts.

The probable demand for parts is estimated by past performance from the stock card plus a careful investigation and conference by executives from the service, production and engineering departments. More than often, an unusually troublesome part is supplanted by a modification which checks the trouble. This part usually goes into regular production before the transfer. In the conference mentioned previously, the replacement executive is advised of changes or impending changes by the executives from other departments and can regulate his stock in accordance with the probable demand from cars which have been equipped with the troublesome part.

For the regular run of replacement parts, the stock card provides an index of the rate of demand. Over the long haul, this demand naturally decreases to zero. In advanced practice, orders are placed for three months and are based on an average for the previous six months. That is, the demand for the previous six months is divided by two and determines the amount of the next order. A casual mathematical analysis of this procedure will demonstrate that the amounts of the succession of orders ultimately approach zero as cars of that particular model disappear from registration.

The relationship of the stock card to ordering and the routine in the shop and office as well as to shipping arrangements can be demonstrated by a description of the operation of the Packard replacement department. This department is one phase of a service plan which has been the subject of intensified study for several years and furthermore is profitable as regards operation. The method of determining the size of order to be placed in the replacement parts shop is along the general lines of the previous paragraphs. A well equipped separate plant provides the physical machinery of the service organization. Stores, incoming orders and the method of handling outgoing shipments are based on careful study of the large mail order houses.

This stock card, shown in Fig. 1, is approximately 9½ in. by 12 in. and is designed for use in accounting machines. The various headings cover orders for incoming material, the condition of these orders, and entries for every outgoing shipment. In the upper left hand corner is a section for recording total monthly shipments for four years. It is this section which forms the basis for estimating new production orders. The back of the card carries continuations of the "stock," "stock orders" and disbursements columns. The head of the card proper discloses the name and part number of the piece, net and cost prices, bin location, rough part number and minimum amount to be carried. This last item is corrected from time to time in accordance with the information concerning monthly activity.

Outgoing Shipments

Outgoing shipments are entered by girls from copies of the orders of distributors. The destination and quantity of each order as well as the balance on hand are entered. When the amount on hand appears low, the card is passed over to an order clerk for attention. At such times an inventory of the shipping bins usually is made and possibly the surplus or excess stock will be examined. If these points indicate an impending shortage, a new order is placed.

Each order is carefully censored before final final issue. For material which will be complete upon receipt from outside sources, the order passes from the order clerk to the chief order clerk, to the service pricing department and then to the assistant manager of the division before being placed with the general purchasing department. Internal orders go through the same channel and then are passed upon by a conference including representatives from the engineering department, the methods division and service pricing division.

Planning of the operations and progress through the shop is done by a department which is an inherent part

of the division. Operation sheets are made and revised from time to time just as in the regular production department. Scheduling is handled by a department in the shop which gives rush orders the right of way in case of conflct at any machine or department.

Rough stock is carried just as in the regular production department. Forgings and castings which can be made in the production plant are ordered from the proper departments. Major stampings such as fenders are ordered in the same manner and must be made between production runs.

Incoming orders are received in quintuple from the distributor, who also retains a reference copy. A typical blank is shown in Fig. 2. Five similar sheets are designated for the following purposes: Service stores-stock and shipping copy; section copy; packing copy; factory Service Office Reference copy; acknowledgement copy.

Upon receipt, the time is stamped, piece numbers are checked against names and each item is priced. The order for only one type of piece is written in each of the sections of the face of the order when made out at the distributor's office. The bin number of each item is written into the same section and then a collection time and checking bench number is stamped on each section.

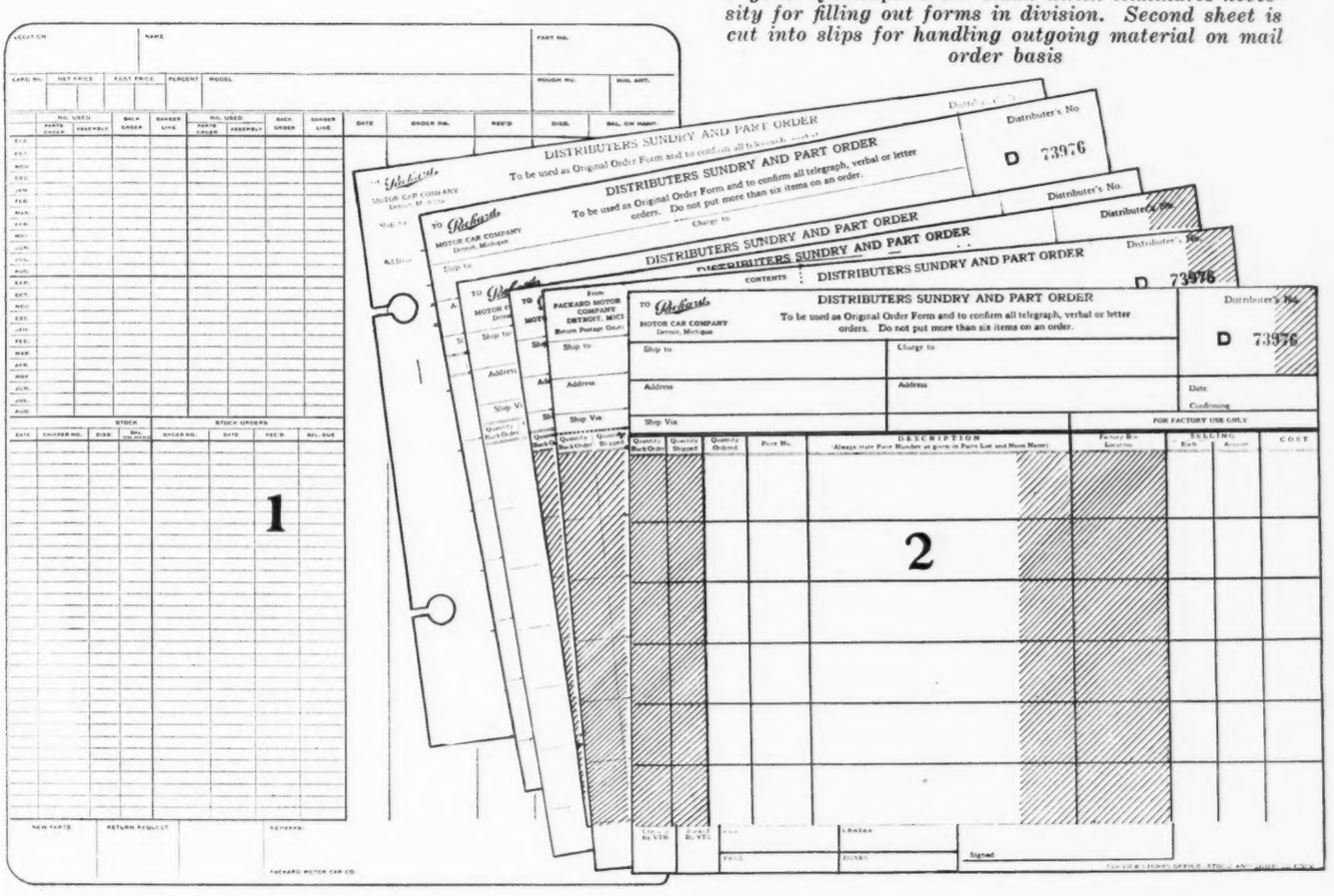
Orders are then passed into a distributing room where a girl takes the section copy and cuts off each of the sections in a blue print trimming machine. The section copy carries duplicates of the order number at the top on each of the six sections of the order. These strips are distributed into folders for the various bin sections and the collection time. The collection time is based upon hourly distribution of the order and removal of the material to the packing room. For an order which is to go to assembly bench A at eleven o'clock, each strip is stamped A-11. In case of a parcel post shipment, the head of the section copy is used as the address label on the final package.

From this room, the orders and slips are distributed to the bin sections and checking benches in the adjoining active storage room. This room is several hundred feet long and nearly 100 ft. wide. At the end nearest the office, the checking bench extends along the inner wall with openings to the packing department on the opposite side of the partition. These benches adjoining an aisle which extends the length of the room. At right angles to this aisle are the bin sections with narrower aisles between. The bins are about sixty feet long and eight or ten ft. high. One man tends each section of more than thirty in this room. At each section is a tray in which slips for parts in that section are deposited in hourly groups. The balance of the quintuple order is delivered to the designated checking bench.

Small parts are placed in the bins nearest the head of the room and the sizes increase toward the lower parts of the room which contains fenders, etc. No frames are handled in this department due to their bulk and inactivity. The stock in this room is the active material and only enough is carried for current requirements. This stock is reinforced by surplus and excess stock rooms on the second floor. But these stocks are not arranged for quick handling as is the stock on the first floor. No attempt is made to classify material in the bin sections in the active stock room. In fact the tendency is altogether in the opposite direction in order to prevent the possible substitution of a similar part.

Fig. 1. Stock card used in Packard Replacement Parts Division. In addition to supplying perpetual inventory, this card supplies history of activity of part for ordering

Fig. 2. Quintuple order blank which eliminates necessity for filling out forms in division. Second sheet is cut into slips for handling outgoing material on mail order basis



A man passes up and down the aisle at heads of the bin section constantly and delivers material which has been matched with order slips to the designated checking bench. Also he reports delay and failure of any section to fill orders in the specified hourly interval. At the checking bench the slips and material for a specific order are assembled with the order and checked and then are passed through the opening in the wall to the packing department. By routing parts to a predetermined checking bench, orders from one distributor are brought together so that they can be shipped to the best advantage. The packing department assembles the various orders and if possible ships them in one container. One copy of the quintuple order is used as a packing slip. Another copy is returned to the distributor by way of acknowledgement when the incoming order is checked. From the packing department, the balance of the original order is returned to the office for record purposes.

Shortage of Material

In case of temporary shortage of material, the slip for the particular part is placed on the back order list and the order is annoted accordingly. If possible a shipping date is marked on the copy which goes back to the distributor. This part is given special attention until shipment is made. Boxes, crates, parcels, etc., are passed from the packing department to a conveyor which handles the outgoing shipments.

Telegraph orders are given preference. Incoming wires are attached to a form as shown by Fig. 3 and accompany a special quintuple order blank which is made out in the office of the division. In the office all filled orders are recorded by punching them on Holerith tabulating cards as shown by Fig. 4. These are passed through the Holerith machines then and are first selected by the code for the various distributors so all of the orders from one source are billed together on an invoice, Fig. 5.

Experience in replacement parts manufacture from all angles has dictated several divisions of the office work in order to place definite responsibility and to insure that each item will receive specific attention. Primarily, the office is divided into groups which handle incoming and outgoing parts respectively. The work of handling stock and purchase or manufacturing orders is subdivided into units which pertain to particular models or classes of general material.

The shop is unusually clean and orderly and has a complete internal organization with inspection department and a tool room which is almost a model installation. In general the shop is departmentalized with drill presses, lathes, milling macines, etc., in separate departments. Outstanding exceptions to this policy are the gear and highly finished shaft department which contains a complete line of equipment for this class of work and the heavy machine room for parts such as cylinders crankcases, truck axle housings, etc. In this department, standard heavy machines, such as Ingersoll planer type milling machines, boring mills and heavy duty drill presses with adjustable spindles, and some special machinery are gathered.

A shop planning and scheduling department adjoins the special tool storage where jigs, fixtures, etc., for old models are located. While the shop contains a liberal amount of all kinds of equipment, this is done to protect schedules and prevent stringencies at one particular machine. Depending upon the type of work going through the shop and its stage of progress, some departments will have practically all machines in operation while in another only a fraction of the equipment will be busy. Machine tools for this division are purchased with the same care as for the production line as it is believed that service work demands the same accuracy as new production. Therefore this department is not permitted to become the graveyard for outworn production equipment.

Due to the type of management which places specific responsibility for maintaining stocks, the methods and equipment in the shop and the mail order type of shipping organization, the material is on its way to destination within a few hours of the receipt of the order.

RECENT introduction in Chile of a high-priced and two medium-priced American cars has augmented automotive competition. On the other hand, agency arrangements have been discontinued by three American manufacturers. The automotive market in Chile is pictured as dull with a general depression felt during the second quarter.

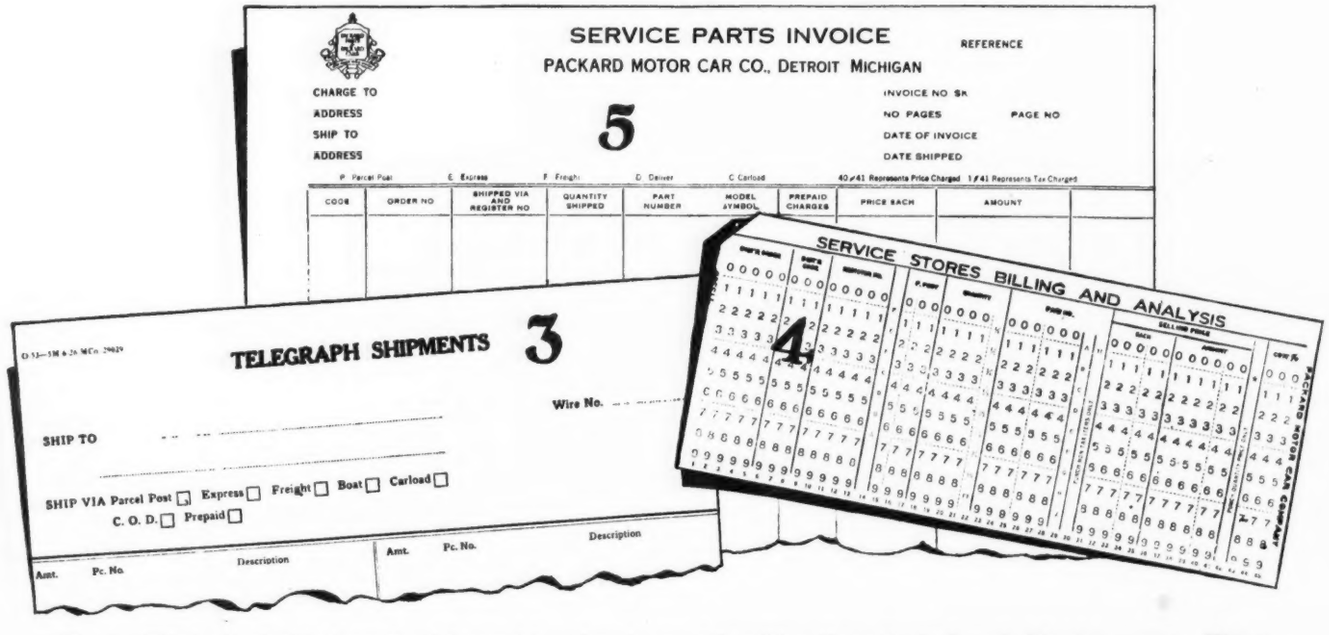


Fig. 3. Blank attached to incoming telegraphic orders to speed handling through stock and shipping rooms. Fig. 4. Tabulating machine card which is punched according to outgoing orders. Provides segregated information for billing, analysis, etc. Fig. 5. Invoice which is made out from data tabulated from cards

Production Grinding Today *in* Automotive Work

More important advances have been made in this field in last five years than in any other branch of machine shop work. A description of operations and machines.

By P. M. Heldt

DURING the past five years more important advances have been made in production grinding than in any other branch of machine shop work. This may be accounted for by the fact that production grinding itself is of comparatively recent origin, dating back only to the inception of the automobile industry. Previously the only forms of grinding in common use were tool grinding and the dressing of castings in the foundry. The demand for grinding in production operations came with the adoption of the tougher alloy steels as materials of construction (which are hard to cut with steel tools), and with the introduction of the system of interchangeable parts, which called for greater accuracy.

Already in 1921 a great many automobile parts were finished by grinding, but a number of further applications have been made. The majority of the improvements made in grinding processes and equipment have had for their object either an increase in production or an improvement in the accuracy and finish of the parts. A number of the outstanding developments in grinding machinery and grinding processes during the period mentioned are listed below:

Wide wheel grinding has largely superseded grinding by narrow wheels traversed across the work.

Centerless grinding has been introduced and is widely used for simple cylindrical and tapered parts.

For finishing cylinder bores multiple spindle machines have been introduced which carry grinder heads containing multiple abrasive stones.

A multiple spindle cylinder grinder has been developed in which the wheels have a plain rotary motion and the cylinder block is given an eccentric motion.

Grinders are designed much more substantially, with much heavier spindles and spindle bearings and flood lubrication to same, to permit of higher rates of production.

Numerous attachments for grinding machines have been developed, to facilitate the loading and unloading of the machines and of truing the wheels, and for steadying the work.

Piston rings are now ground in automatic machines with magazine feed. They are ground on the sides only, the outer surface being finished by turning.

Hydraulic feed and traverse has been applied to many of the newer machines.

Automatic and semi-automatic machines have been introduced to reduce the manual labor required and speed up production.

A platen type of surface grinder has been placed on the market which has proven very handy for finishing the joint surfaces of manifolds and other similar parts.

IN this article a number of advances in the grinding art are described in a general way, and in a number of instances the application of new methods in practice is illustrated by reference to results obtained with machines of a particular make. It is not to be inferred from this that the manufacturer whose machines are thus mentioned or illustrated was necessarily the originator of the particular method or practice. While it would have been ideal to give credit to those responsible for different advances by choosing their products as illustrative examples, the difficulties and pitfalls of the task of determining the true pioneer in each case were obviously too great.

—The Editor.

The disk grinder has been greatly developed and in some of its forms is now a regular production machine

Gear grinding by means of tooth-form generating machines has been introduced and is now used in many plants to finish the tooth surfaces of transmission gears.

Splines of transmission shafts and sliding gears are now finished by special grinding machines, those of the gears true with the pitch circle.

Two-wheel grinding has been applied to such parts as crankshafts, stem pinions, etc., to increase production.

In this connection a word regarding the extent of grinding work in automotive production may not be amiss. Practically all finishing operations on automobile parts are by grinding, and some parts are ground to size from the rough. As a rule the higher the general quality of the car the more grinding work it has done upon it. It has been estimated by one authority that from $1 to $4 is spent for abrasive wheels per car in different plants and that the total annual expenditure of the automobile industry for grinding wheels amounts to approximately $8,000,000. In addition to this the industry pays out considerably more than a million dollars for diamonds for truing the wheels.

It is a rather curious fact that most of the loss of

abrasive results not from the actual grinding but from the truing and dressing of the wheels.

Recently considerably economy with respect to wheel wear has been claimed to result from the use of wheels of unusually large diameter. Another suggestion with respect to the more economical use of abrasive is to make the wheels with large holes so that not so much of the rather costly artificial abrasive needs to be thrown away when the wheel has reached the limit of its serviceability. For certain purposes, as, for instance, in crankpin and cam grinding, it is impossible to use the wheels beyond a certain minimum diameter, and wheels that have been worn down to the limit for such work are transferred to other operations.

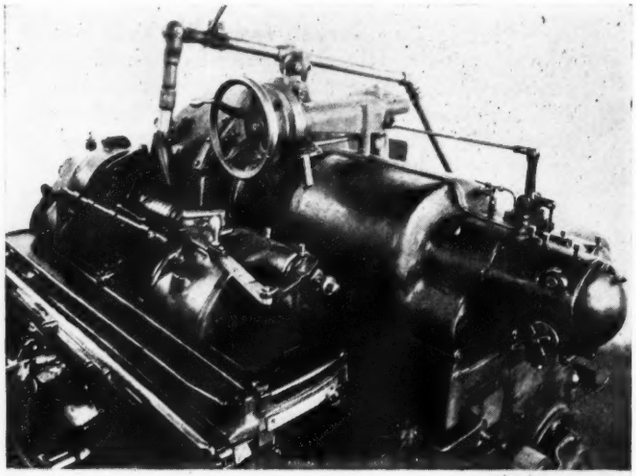
Straight-in Feed

In all early grinding operations comparatively narrow wheels were used which were traversed across the work. In that case, evidently, only the forward edge of the wheel is effective in cutting; the edges wear away comparatively rapidly and the wheel needs truing quite frequently. By using the wide wheel, straight-in feed principle, production can be greatly increased. Straight infeed, it seems, was first used in grinding crankpins, the wheel being made of the exact width of the pin and having its corners rounded for the fillets. It has been found that to produce a smooth finish without wheel marks it is necessary to oscillate either the wheel or the work. When grinding crankpins this is not done, and the resulting surface therefore is not as good as might be desired, which has recently led to the introduction of the lapping process for finishing crankpins.

Usually in straight-in grinding the wheel spindle is oscillated axially. The Norton Company in 1922 brought out an attachment by which the wheel spindle is reciprocated axially ⅛ in. thirty times per minute. The mechanism consists of a worm and wheel, the latter on a shaft having an eccentric upon it. A pivoted yoke in contact with the eccentric transmits the motion to the wheel spindle. When the wheel is to be trued the yoke is thrown out of contact with the eccentric by means of a lever. The effect of the reciprocation is said to be to improve the finish, increase production and reduce the frequency of truings.

Fig. 1 shows ball races being ground on the outer circumference in a Landis wide wheel grinder with reciprocating wheel spindle and mechanical straight-in feed to the wheel head. A toggle arrangement on the footstock serves to operate the spindle. The bearing races have an outside diameter of 3.5433 in., and 0.035 in. stock is removed by a grinding wheel 24 in. in diameter and of 9 in. face. The production is 385 per hour, the tolerances being —0.000 and +0.0005 in.

Another typical straight infeed job is the grinding of the Franklin transmission brake drum. This drum is 8⅝ in. in diameter and 3¾ in. wide and is ground to size from the rough casting.



Above: Fig. 1. Grinding anti-friction bearing races in wide-wheel grinder with straight-in feed (Landis)

Below: Fig. 2. Grinding shouldered work in Cincinnati centerless grinder

Centerless Grinding

AN outstanding development of the last few years in the grinding field has been the process of centerless grinding. In this process the work is placed between two abrasive wheels, one of which, known as the grinding wheel, rotates at such a speed as to give the normal peripheral wheel speed of about 6,000 ft. p.m., while the other, known as the regulating wheel, rotates at a much lower speed. The work rolls on the regulating wheel and the peripheral speed of the regulating wheel therefore determines the work speed. A work rest supports the work.

If the work is of a plain cylindrical character, such as piston pins, the axes of the two abrasive wheels may be set at a slight angle with each other. A longitudinal motion is then imparted to the work and it is automatically ejected from the machine when the grinding operation is completed. Such a machine can be readily furnished with automatic feed.

At first the centerless grinder was used only for straight cylindrical parts, but the process has been developed rapidly during the past year and it is now possible to grind tapered parts and parts having shoulders. The Detroit Machine Tool Co., one of the manufacturers of this type of grinder, recently turned out an improved machine for both "straight through" and shoulder grinding, which is made in both automatic and semi-automatic forms. A camshaft controls the various movements in the grinding operation, and the cam is adjustable for depths of cut varying from 0.0005 to 0.202 in. Thus the operation is a cyclic one and the rate of production on any particular piece is fixed. In the automatic type the work is fed by a magazine. The grinding wheel is fed straight in against the work, is oscillated in an axial direction at the completion of the cut, and is then returned to the loading position. The completed piece drops into a chute while a new piece drops into position for grinding. Wheels up to 8 in. in width can be used. By making the regulating wheel of a hard composition, a

high coefficient of friction with steel is obtained and the abrasive effect reduced to nothing.

Piston pins are now ground almost exclusively on centerless grinders. In one plant the pin is finished in three passes through the machine, removing a total amount of stock of 0.014 in. In another plant, producing a high grade car, three passes are used for rough-grinding, removing 0.0005, and 0.005 and 0.0025 in., respectively; then two finishing passes, removing 0.0015 and 0.0005 in., respectively, and finally the pins are lapped.

A typical shouldered part ground in centerless grinders is the poppet valve, which is ground on the stem. Valve stems ⅜ in. in diameter by 6 in. long can be ground at the rate of 350 per hour, a roughing and a finishing pass being used. In grinding by this process, no attempt should be made to remove more than 0.005 in. per roughing pass, while for the first finishing pass 0.002 and for the second 0.0005 in. is recommended. A similar part is the spring shackle bolt, which is ground at the rate of 400 per hour.

Franklin uses the centerless grinder for long tubular parts that must be accurately finished at one part of the outer cylindrical surface, such as the steering column tubes and the front axle tube. The free end of the part is held in a special steady-rest in such a way that the section of the tube requiring to be finished comes between the wheels.

Economical production is the chief virtue of the centerless grinder, and it is a good plan to consider the possibility of using it for all parts requiring the grinding of cylindrical, tapered or formed surfaces. At first the process seemed to have many limitations, but these are gradually being overcome and its use in automotive production is widening all the time. Pistons are now frequently ground on centerless grinders.

An unusual application of the centerless grinder is to the finishing of ball studs used for steering arms. This was developed by the Cincinnati Milling Machine Co., manufacturer of the Cincinnati centerless grinder. First the taper shank is finished by a straight in-feed and then the ball, by the use of a wheel which is dressed to the required form.

Hydraulic Feed

In both internal and cylindrical grinders the main table is now frequently traversed and the wheel fed against the work by oil under pressure or by what is known as hydraulic power. Oil pressure operation is preferred to direct mechanical operation because of the absence of shock and vibration, because it gives greater sensitiveness of control, and because it gives a much greater range of traversing speeds, making possible the rapid traverse. Hydraulic mechanism is used also for other purposes on grinders. Thus crankpin grinders are provided with hydraulically-operated work clamps for the work carrying fixtures and with hydraulic steady-rests.

In order to reduce the manipulations required of the operator and thus make possible increased production, automatic features were introduced in grinding machines in 1925. The Norton Company that year brought out a semi-automatic cylindrical grinder in which starting and stopping of the work, the flow of grinding compound to the wheel and the continuous power infeed with rapid return at the end of the cut were all effected automatically by means of air cylinders and valves, through the intermediary of a cam. The movement of a single lever started the cycle of operations.

Heald about the same time brought out an internal grinder embodying similar features. With this machine,

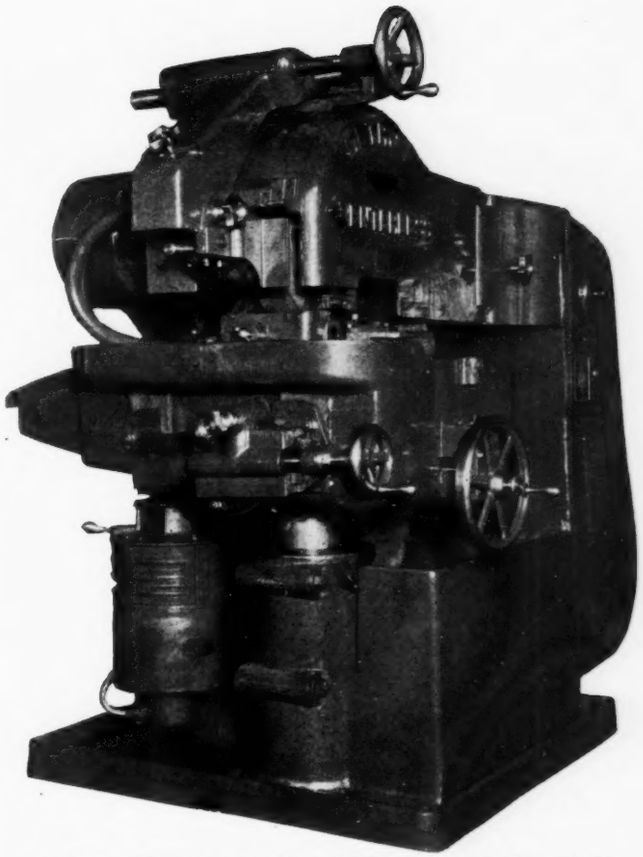


Fig. 3. Detroit centerless grinder, in which the grinding wheel is located above the regulating wheel

after inserting a piece of work in the chuck, the operator locks it by means of a collet lever and then starts operations by throwing a reversing lever. The wheel head then moves from its position of rest at the extreme right, at full speed up to the work. When the wheel is about to enter the work the wheel head automatically slows down to the grinding speed. It is then traversed through the work back and forth, the length of stroke being set to correspond to the depth of the hole, and at each end of the stroke it is automatically fed toward the work by a predetermined amount. When the hole is within 0.003 in. of the finished size, the cross feed is automatically reduced to 0.0002 in. per stroke, for the finish grinding. Noting from the indications of the dial that the rough-grinding has been completed, the operator lifts a latch, which allows the wheel to run out beyond the limit of the grinding stroke sufficiently to allow it to be trued up for the finish-grinding. The truing diamond is brought into position by the operator tripping a lever, and by means of another lever he reduces the rate of wheel travel. The wheel is brought back to its former rate and limits of travel automatically and the diamond holder is pushed out of the way in a similar manner.

Later the same year Heald came out with a full-automatic machine, in which the wheel stroke is automatically lengthened for the truing operation and the only thing that remained for the operator to do was to unload and load the machine.

Previous to the introduction of these automatic features, sizing indicators had been developed, which constantly indicated to the operator how much stock still remained to be removed from the work.

The general principle of these devices may be gathered from the following description of the sizing indicator recently brought out by the Bryant Chucking

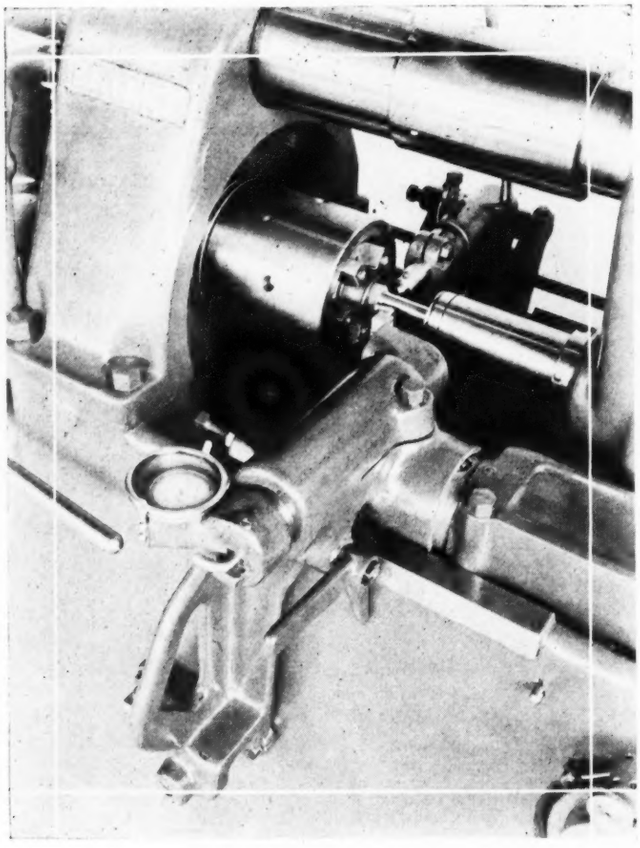


Fig. 4. Bryant automatic sizing indicator

Grinder Co. for attachment to its various internal grinders. This consists of a diamond gaging point in contact with the wall of the hole being ground, a dial indicator and means for communicating the movement of the gaging point to the dial. The diamond is carried on a small arm that projects into the indicator; it is smoothly finished on the contact surface to a radius equal to that of the smallest hole to be ground. When changing work pieces the device is withdrawn from the hole and swung out of the way.

Another development in the direction of minimizing the annual labor required in the operation of the machines consists in the provision of pneumatically controlled headstocks and foodstocks. These features are found on the Norton Type B semi-automatic special purpose machine, for instance.

Surface Grinding

PLAIN surfaces can be ground either with the circumference of a wheel of the ordinary type or with the side of a ring wheel. Surface grinders making use of the first mentioned principle usually have a horizontal wheel spindle, while those employing the second principle generally have a vertical spindle, though recently a machine has been introduced which grinds with the flat side of the wheel and has a horizontal spindle. A typical machine of the vertical spindle type is the Blanchard, which is found in many automobile plants. In the Packard plant, for instance, the top of the cylinder block is finished by grinding in one of these machines, 1/64 in. of stock being removed. This is an application to work of large size of which a single piece is worked upon at a time, but the machine also lends itself to operation on small parts which may be help in suitable fixtures.

Recent applications of this kind are as follows: At the Chrysler plant the crankshaft counter-weight forgings are ground on two parallel surfaces. At the plant of the Ross Gear and Tool Co., manufacturers of steering gears, the sides of a projecting fork on the trunnion shaft are ground. Ford and Dodge grind valve tappets square at the ends and to length in a Blanchard machine with automatic clamping fixtures. Oakland and Olds grind the piston head to secure a smooth surface which absorbs less heat and to which carbon does not adhere so well. The Houde Engineering Co. of Buffalo, manufacturers of hydraulic shock absorbers, grind the ends of the shafts carrying the wings or paddles of the shock absorbers, using a special magnetic fixture for the purpose. The same machine, known as the Blanchard Model 16-A, is used in many ball bearing plants for grinding the faces of ball races.

A rather unique design of surface grinder is the Osterholm, made by Williams, White & Co. of Moline, Ill. This machine has a heavy cast iron bed supporting the wheel head. The work table is supported on a heavy trunnion which oscillates in bearings in the base. By means of a cam on the side of the machine the table can be raised and lowered. This movement of the table occurs once for a given number of wheel revolutions and marks the completion of a cycle, the operation of the machine being entirely automatic aside from the loading and unloading.

The work is loaded into the fixture, which is mounted on the work table. The operator starts the machine by pushing the control handle, which shifts the auxiliary belt and starts the feed cam and the oscillating mechanism of the trunnion. The work table then rises to the operating position, and the wheel housing is driven forward by the cam to the determined position, where it remains during several oscillations of the work table. This grinding interval is sufficient to allow for any unevenness in the surface of the work. The cam finally raises the follower, and drops the work table to the unloading position, at the same time automatically shifting the auxiliary belt.

At the plant of the Packard Motor Car Co. the Oster-

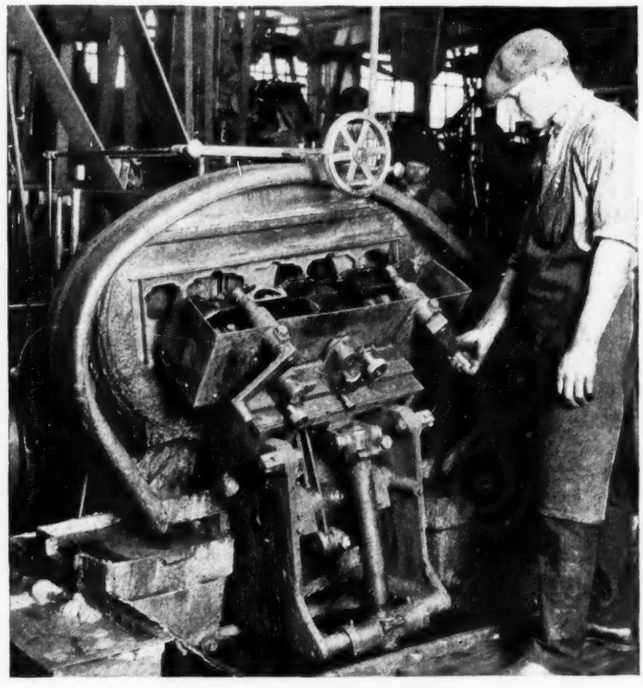


Fig. 5. Osterholm platen type of grinder at work on Packard manifold

holm grinder is used for grinding such parts as the engine front end drive cover plate, the exhaust manifolds and both sides of both ends of the connecting rods. All surfaces are ground from the rough and finished in one operation. The machine has a wide range of uses, but special holding fixtures must be developed for each job. In finishing the bosses on the ends of the Packard connecting rods, four rods are placed on the fixture at the same time, the two ends fitting over studs of the exact diameters of their bores. One of the illustrations herewith shows the Osterholm grinder working on the Packard manifold.

Other parts ground on the Osterholm grinder in automotive plants include crankshaft main bearing caps and flywheel housings. Cast iron combined inlet and exhaust manifolds 24 in. long are ground in this machine at the rate of forty per hour, the tolerance being 0.005 in.

A particularly interesting operation on the Osterholm grinder at the Packard plant is the finishing from the rough of the surfaces on the pressed steel rear axle housing to which the gear carrier and cover plate bolt. An average of 0.025 in. of metal is removed from these surfaces.

Surface grinders of the larger sizes are now often provided with a number of blocks of abrasive material instead of with ring wheels. The blocks are cheaper to manufacture and less liable to injury during transport, and they, therefore, materially reduce the cost for wheels. The Diamond Machine Co. of Providence, R. I., among others, manufactures such grinders in two sizes, with twelve and fifteen blocks, respectively. Pratt & Whitney also use blocks instead of ring wheels.

Combined Cylindrical and Surface Grinding

OCCASIONALLY grinding operations are required on adjacent cylindrical and plane surfaces which must be absolutely at right angles to each other. An instance of this kind is the side gear of the differential, the hub of which must be ground because it forms the supporting journal and the back face for the thrust bearing. Formerly this was accomplished with an ordinary wheel, the circumference of which ground the cylindrical surface and the side the plane surface. By this method it was quite impossible to obtain a smooth plane surface, and tangential wheel marks would plainly show.

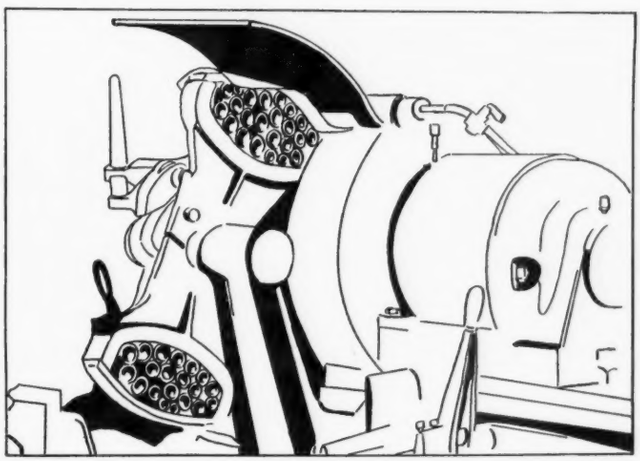


Fig. 7. Grinding ends of coiled springs in disk grinder with double-ended holding fixture

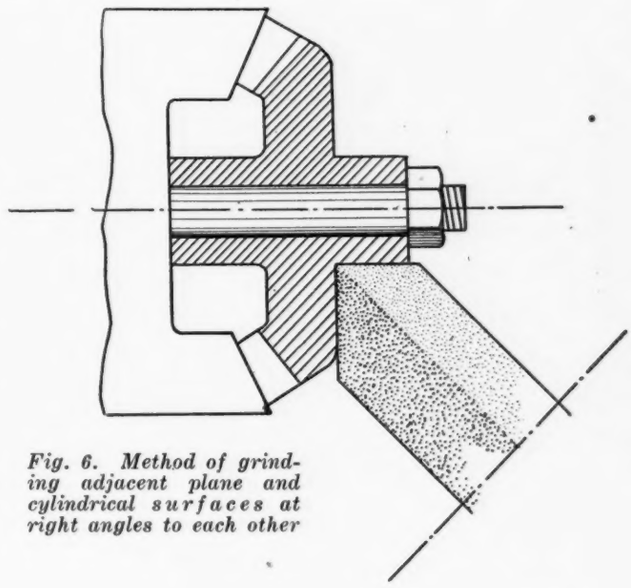


Fig. 6. Method of grinding adjacent plane and cylindrical surfaces at right angles to each other

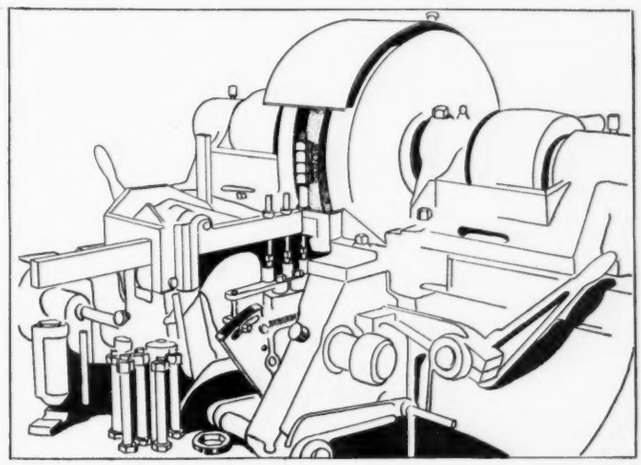


Fig. 8. Grinding hexagon nuts and spark plug shells in Badger disk grinder

By a new method, which is used in the plant of the Timken-Detroit Axle Co. and elsewhere, these side gears are ground by means of a wheel having two conical grinding faces and which revolves around an axis making an angle of nearly 45 deg. with the axis of the side gear, as illustrated by the sketch Fig. 6. Whatever wheel marks there are on the plane surface when this process is used, are concentric with the axis of the side gear and are then less objectionable.

Disk Grinding

RATHER closely related to surface grinding is modern disk grinding. The original disk grinder, which appeared on the market some thirty years ago, consisted of a floor stand supporting bearings for a shaft carrying a steel disk at each end, the outer surface of each disk being covered with emery cloth. Work tables were supported by a rocker shaft projecting from each side of the floor stand. Not much metal could be removed with a machine of this type and it was used chiefly for light

finishing or polishing operations. It was impractical to do "wet" grinding, and the emery cloth had to be replaced frequently.

In modern disk grinders of the heavier type the emery cloth facing is replaced by abrasive disks of sufficient thickness to permit of repeated truings. These abrasive disks are secured to the steel base by gluing or shellacking. Much improvement has been made also in the work tables and the fixtures for holding the work. One interesting operation in automotive production for which such grinders are used is the grinding of both ends of coiled springs to make the ends perpendicular to the axis and prevent "cocking" of the springs in service.

A machine for this purpose is manufactured by the Gardner Tool Co. of Beloit, Wis. The grinder has two wheels facing each other and both rotating in the same direction. A double-ended holder (Fig. 7) is used for the springs, one end being loaded while the springs in the other end are being ground. Each end holds eighteen springs at a time. The fixture or holder with the springs is introduced between the wheels while these are moved apart, hence it is not necessary that the springs be located in the holder very accurately endwise. When the machine is started, one of the wheels feeds in and centers the springs between the wheels, as it were. In order to prevent the wearing of grooves on the wheels the holder is reciprocated slightly.

Hexagon nuts and spark plug shells are also ground on Gardner disk grinders. The operator loads the rough nuts on arbors and places three of these arbors on vertical pins on a work-holding fixture (Fig. 8). Then the work-holding fixture is moved inward by means of a lever, whereby the nuts are brought between the wheels and two opposite faces on them are ground. When the work-holding fixture is withdrawn by means of the lever the arbors are automatically indexed through an angle of 120 deg., and when the fixture is then moved forward again two other faces of the nuts are presented to the wheels and ground. A second indexing and feed motion completes the hexagon.

Grinding Piston Rings

A GREAT many piston rings are now made from individual castings, from which only comparatively little metal needs to be removed, and as this consists of the scale and the layer directly under it, which is abnormally hard, it can be removed more cheaply by grinding than by turning.

The rough grinding on the blanks is now often done in disk grinders. Chas. H. Besley & Co. of Chicago make

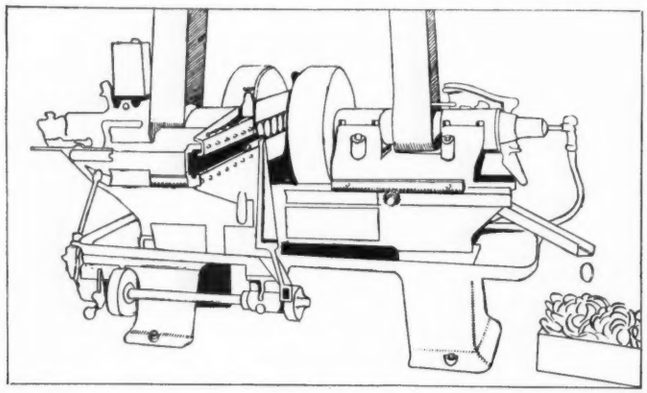


Fig. 9. Grinding piston rings on both sides in Besley disk grinder

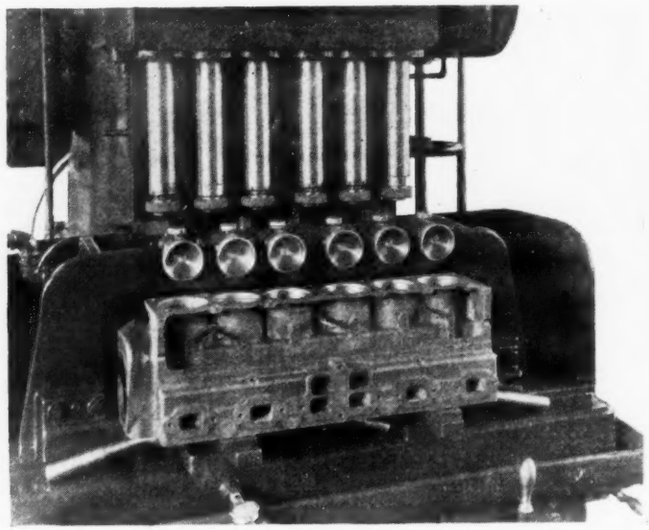


Fig. 10. Pratt & Whitney six-spindle cylinder grinding machine

a special double-wheel disk grinder equipped with a feeding fixture which automatically slides the rings between the wheels (Fig. 9). The machine itself is a standard model and only the work feeding device is special. The rings are fed through a device with a V-shaped trough, located to the left of the fixture and close to the wheels. From the trough the rings are fed to the fixture by a sliding member. When a ring is fed into the machine, one of the wheels is slightly withdrawn, and when the ring is about three-fourths of its diameter between the wheels, a cam releases the spindle and this wheel moves into the grinding position. For sizing the work, both spindles are adjusted by micrometer screws. The fixture is driven by a 1/3 hp. motor through spur reduction gears, or by belt directly from the countershaft.

As an example of the capacity of this machine, it may be stated that twenty-four hundred rings 3½ in. in diameter and ⅛ in. wide are ground per hour on both sides. About 0.008 in. of stock is removed from each side and the work is held to tolerances of plus and minus 0.0015 in., with a tolerance of 0.001 in. on parallelism.

Finish grinding of the sides of piston rings is accomplished in automatic machines of the wheel type, such as made by Heald and Arter. These machines, of course, can be used also for the rough grinding and are widely so used. For instance, twenty-seven of the Arter machines are in service at the plant of the Perfect Circle Piston Ring Co., Hagerstown, Ind., being used for both roughing and finishing. Piston ring grinders of this general type, employing magnetic chucks, have been in use for a great many years, but the automatic feed devices, which greatly increase production, have been introduced within the last five years. Machines of this type have a capacity of about one thousand ring sides per hour.

Cylinder Finishing

FIVE years ago practically all engine cylinders, with the exception of those used on low priced cars, were finished by grinding, special cylinder grinders being built for the purpose. The process was not entirely satisfactory, however, partly because the rate of production was not sufficiently high for modern requirements and partly because the finish obtained, although materially better than that obtainable by reaming, was not as good as de-

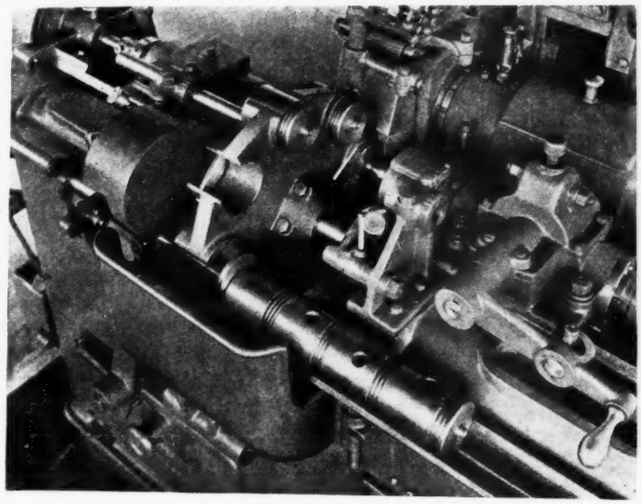


Fig. 11. Indexing fixture for grinding pistons in cylindrical grinder (Arter)

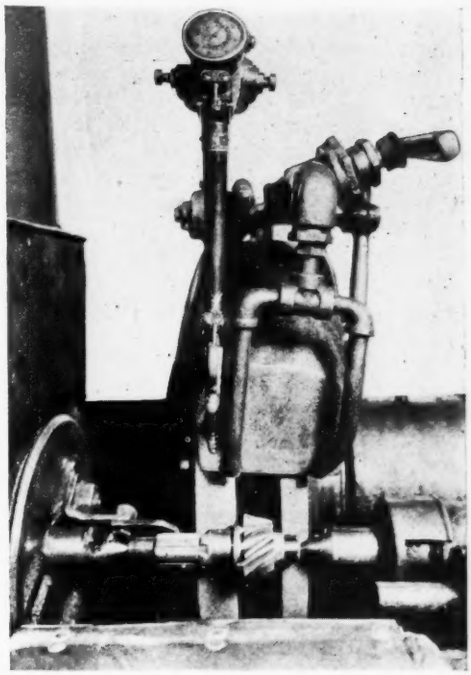


Fig. 12. Twin wheel grinding of stem pinion (Norton)

sired. The comparatively slow rate of production was due to the fact that the grinders could be built only in single spindle form, and this limitation naturally became painfully evident with the introduction of six and eight cylinder blocks. As regards finish, what is desired is the same mirror-like finish which a cylinder acquires after having been in use for some time. If this can be produced during production it is unnecessary to "run in" the car or "nurse it along" for the first 500 miles.

The objections of production men to grinding by standard cylinder grinders were well summarized in a recent S. A. E. paper by A. R. Fors, production engineer of Continental Motors Corp., Detroit, as follows:

1. Grinding with a small wheel rotating at a high speed produces a fuzzy finish that is worn away quickly and requires an early regrinding of the bore.
2. The grinding wheel is not supported rigidly enough and the tendency is to produce chattering, especially when hard spots are encountered in the bore.
3. Grinding dry produces an out of round bore, due to the heat generated.
4. The machine requires specially trained operators; at various times we have found it difficult to maintain production because of lack of capable operators.
5. Grinding machines require more constant attention from an experienced repairman than any other production equipment, to keep the spindles and other parts of the machine in condition to produce satisfactory results.

At the present time multiple spindle machines with grinding tools carrying a number of abrasive stones are largely used for finishing cylinder bores. The Hutto grinder, which was fully described in these pages some months ago, is being used in regular production in a considerable number of plants. Usually the bore is first turned, then reamed and finally finished with this grinder. Several manufacturers grind their cylinders in standard single spindle cylinder grinding machines and then hone them to remove the fuzz left by the grinding wheel, allowing practically no stock for the honing operation.

At the plant of the Packard Motor Car Company a six-spindle cylinder grinder has been developed and is being used at the present time. In the standard single-spindle cylinder grinders there is an eccentric motion which carries the axis of the wheel spindle around in a circle, and by means of a double eccentric arrangement this circle is enlarged to feed the wheel against the work. Evidently this arrangement does not lend itself to multi-spindle construction. Therefore, in the Packard cylinder grinder the work table is given an eccentric motion, each of the spindles revolving around a fixed axis. At first sight trouble would be expected from the inertia of the block, but since the speed of rotation is small this does not appear to be serious. This machine is to be produced for the market by the Pratt & Whitney Co., Hartford, Conn. It will probably be used mainly for rough grinding.

The action of the abrasive stones naturally is rather different from that of the grinding wheel, since the grain of the stones is finer and there is no traverse in the same sense as with the wheel, which is responsible for the fuzzy finish; yet the process may be regarded as a form of grinding, since the cutting action is due to particles of abrasive material.

It has been found a good plan to complete all other operations on the cylinder block before finish-grinding it. Thus all studs should be put in place and the valve stem guides pressed in. If these operations are attended to after the grinding, the metal at the bore is often displaced and the surface of the bore thereby distorted.

Pistons and Crankshafts

PISTONS are ground either between centers or on centerless grinders, the latter method having come into use during the past year. Both methods are very rapid, as in the case of grinding between centers a turret-type of indexing fixture is used (Fig. 11). This is provided near its circumference with cylindrical openings a little larger in diameter than the pistons, and the latter can be loaded into it either by hand or automatically. The machine is provided with a cam which indexes the fixture, operates the footstock to engage the piston between centers, feeds the wheel toward the work and returns it, and finally ejects the piston from the fixture.

Pistons are generally of two types from the grinding point of view—those with a straight taper from end to end and those which are stepped. Both can be ground in one operation. If the piston is stepped the wheel is dressed to correspondingly differing diameters over different portions of its width. Straight infeed is used.

Crankshafts now always have all of their main bear-

ings or line bearings and all of their crankpins ground, and in some few cases the crank arms are form-ground. As a rule, only one pin or one main bearing is ground at a time, and the wheel is then moved across to the other pin in the same plane. Pins in different planes are ground in different machines. This involves much traversing of the wheel and much clamping and unclamping in the holding fixtures, and the effort of designers has been directed chiefly to means for speeding up these operations.

On a four-cylinder crankshaft of large production, all bearings are turned, leaving 0.040 in. on the diameter for grinding. Then the main bearings are rough-ground and the crankpins finish-ground, after which the main bearings are finish-ground. A wheel speed of 6000 ft. and a work speed of 15 ft. p.m. are used. Two of the crankpins are finished in one machine, the wheel being moved across from one to the other.

A recent development in connection with crankpin grinding is double wheel grinding. It is true that this latter process is not limited to crankshaft grinding, but that seems to be its most important application at present. The plan of moving the wheel slide from pin No. 2 to pin No. 3, for instance, does not seem to be a rational one from the standpoint of modern production practice, for even if the traverse is effected by power and at a high rate, the wear and tear on the machine must be considerable. By mounting two wheels on the same arbor, the requisite distance apart, the two pins on the same plane can be ground at the same time and production naturally be almost doubled. This method of two-wheel grinding of crankpins has been in use in one of the largest engine plants in the country for some time and is being introduced in others.

Double-wheel grinding is also used for other work, as, for instance, on stem pinions which have a seat for a ball bearing in front of as well as behind the pinion. One wheel may grind a taper while the other grinds a cylindrical surface, or two cylindrical surfaces of different diameter may be ground at the same time.

In crankpin grinding, owing to the lack of traverse, the surface is not as smooth as desirable, and tool marks show on it. To eliminate these the Packard Motor Car Company recently has begun to hone its crankpins by means of a machine (already described in these columns) which hones all of the pins at the same time.

A direct comparison of the new two-wheel with the old method has been made in the plant, producing four-cylinder engines, above referred to, where the two center pins are ground simultaneously. By the old method of grinding one pin at a time, forty pins were ground per hour and from 500 to 700 pins were ground per wheel, the wheel being dressed after every 20 to 28 pieces. Grinding the two center pins with double wheels, 100 pins are ground per hour, and 45 pins per dressing. The Landis Company recommends the use of very large wheels for this purpose (36 in.). The wheels can be used up only partly on this work and are then used for other purposes.

The Landis Tool Co. has recently developed a hydraulic machine in which all of the pins of a six or eight-cylinder crankshaft can be ground without taking it from the grinder. The crank-carrying fixtures are equipped with clamps operated by hydraulic power which afford a quick, positive method of clamping the crankshaft in position. A single lever controls the operation of these clamps and a safety device is provided which prevents revolving the heads until the crankshaft has been securely clamped.

A quick-acting back-rest is placed on the machine so that it is always in line with the grinding wheel. This rest supports the work in two positions, directly opposite the wheel and also underneath the pin, to counteract the downward force due to the grinding action. After loosening a clamping screw the work rest can be quickly drawn out of position, for removing or placing work in the grinder, and a positive stop is provided which always locates the rest in the same position.

Wheel feed is either by hand or by power—in the latter case by means of hydraulic mechanism controlled by a lever located close to the hand wheel for hand feed. The wheel is fed inward at high speed until it reaches the grinding position, when the feed is automatically reduced to the proper value. The wheel is then moved inward during the grinding operation by power until the work is ground to the proper size. It remains in this position during a certain number of revolutions of the work, to allow it to cut itself clear, and it is then returned automatically by power to the extreme out position, in which it clears all parts when moved from one pin to another.

A rotary hydraulic motor furnishes power through a pinion and rack for traversing the carriage from one pin to the next. By means of a lever the direction of the traverse is determined, while a regulating valve serves to control its speed. A spacing device controlled from

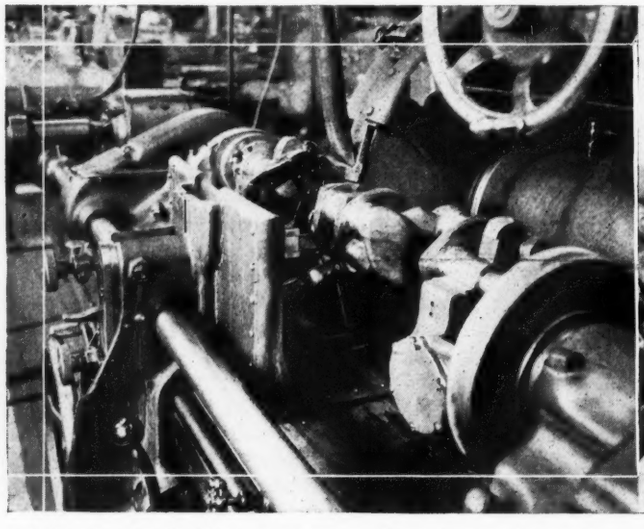


Fig. 13. Indicating gage and work rest shoes in position on Landis crankpin grinder

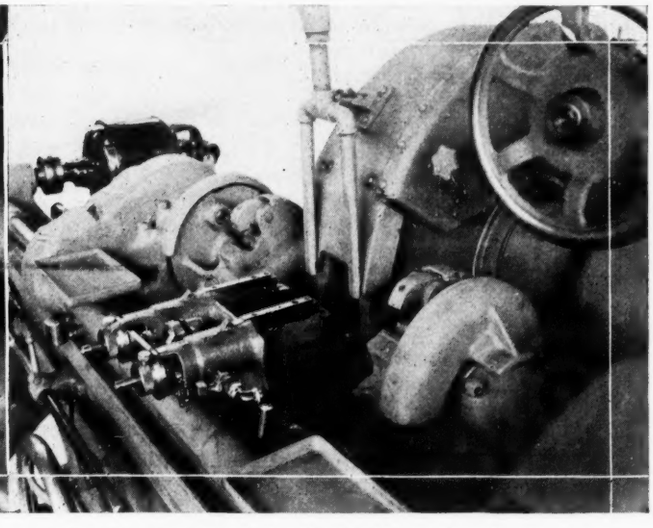


Fig. 14. Detail of Landis double hydraulic work rest and hydraulic work clamp

the front of the machine is provided for bringing the work into the proper position with relation to the grinding wheel.

In operation, the two pins in one plane are ground first, and then the crankshaft is indexed in the supporting fixture. This is done in different ways with different designs of crank, but generally use is made of the holes in the flywheel flange, which is finished and drilled before the grinding operation.

In the illustrations herewith showing this machine at work, the pins worked upon are 2¼ in. in diameter by 1¾ in. long, and 0.060 in. of stock is removed. The floor-to-floor time for the six-cylinder shaft is four minutes. One of the illustrations shows the stationary work rest and indicating gage quite clearly.

Camshaft Grinding

THERE are two well-known machines on the market for grinding the contours of cams and the bearings of camshafts with integral cams—the Landis and the Norton. Both of these were in production at the beginning of the period which is covered in this article, but have been subject to detail improvement. These machines are provided with a number of master cams equal to the number of cams to be ground on each shaft, and as the wheel slide is moved along from one cam to the next, the cam follower is moved from one master cam to the next. The cam outline produced is influenced by the diameter of the wheel, and in order to minimize this influence the wheels are used only till the diameter has been reduced about one inch, after which they are turned to other use.

Among the improvements made in cam grinding equipment may be mentioned a center-pointing device brought out by the Norton Company in 1924. One of the centers supporting the camshaft in the machine revolves, and in order that the work may be accurate it is necessary that the live center run absolutely true. The attachment brought out by the Norton Company made it possible to grind the cam attachment center point quickly and accurately without removing from the master cam spindle. It clamps to the rocking bar of the cam attachment and consists of a body and self-contained motor-driven wheel unit provided with a lever-operated traversing motion.

Norton also brought out a special table type diamond tool holder for camshaft grinders, of extra height to clear the camshaft being ground. The device was designed to give rigid support to the diamond without making it necessary to move the wheel in and out a considerable distance. The fixture is clamped in position for truing by the operation of a single hand lever.

Valve Grinding

THE seats of poppet valves are finished by grinding, and a machine for this purpose has long been made by the Fitchburg Grinding Machine Co. of Fitchburg, Mass. This machine recently has been improved, simplifying and rendering it more rigid, and at the same time making it easier to operate. The operator now merely loads and unloads the spring collet chuck, the grinding operation being automatic. As in other automatic machines, there is a regular working cycle which is determined by the revolution of a cam. The time of the cycle can be varied by means of change gears and the rate of feed by changing cams. Valve seats of from 30 to 60 deg. can be ground on this machine.

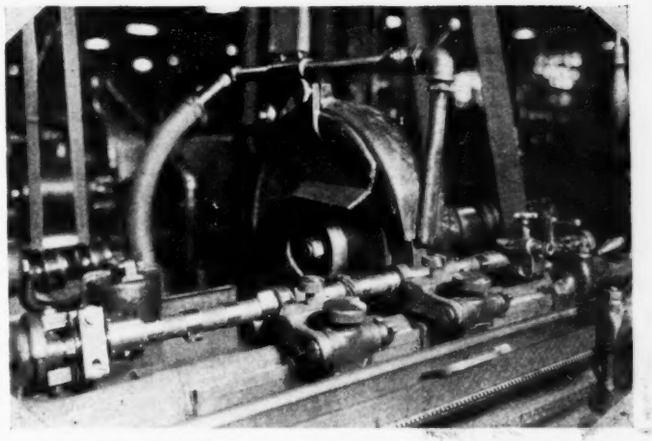


Fig. 15. Grinding an automobile camshaft in Norton cam grinding machine

A grinding operation of particular delicacy is that of the sleeves for Knight engines. One method of grinding the outside of these sleeves is by wide wheel with straight infeed. Sometimes the wheel is about 4 in. wide and is fed straight into the work a number of times until the entire width is covered, after which it is traversed forth and back once. However, in some recent applications, a wheel equal in width to the full length of the sleeve is used.

Gear Grinding

IN any discussion of developments in grinding practice in the automotive industry mention should be made of the subject of gear grinding. Previous to 1920 there was only one method of gear grinding in use in this country, by formed wheels. The machines could not be purchased by manufacturers who, if they wanted to grind their gears, had to send them to the plant of the manufacturer of the grinding machine and ground there. As a result, the process was not adopted for regular pro-

(Continued on page 586)

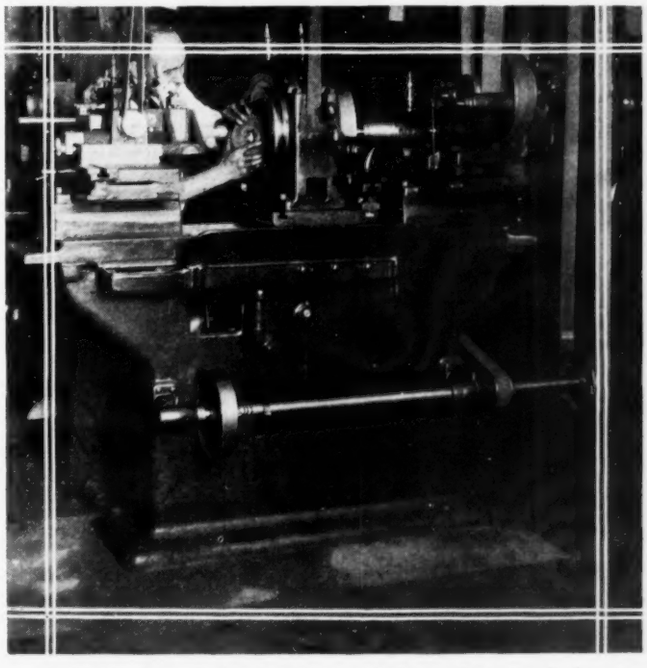


Fig. 16. Internal and spline grinding of transmission gear in Packard plant on converted Heald grinder

Incentive Wage Payment Finding Wider

Many companies in industry now with some incentive plan

By Norman

MOST automotive production men agree that it would be desirable to extend further among indirect workers some form of wage incentive, since this type of payment has proved so successful in stimulating and reducing costs among direct or so-called productive workers.

But the chief question which arises is, "How Can It Be Done?"

This article outlines some of the fundamentals upon which efforts to apply incentives to indirect labor may well be based and then summarizes briefly some of the more important experiments and installations which already exist.

The material gathered together does not answer the important question asked, but it does indicate that a surprisingly large number of factories already are doing something along this line and makes available for reference a summary of some of the more important activities.

NEARLY half of the important passenger car companies in the automotive industry are actively engaged in using or experimenting with methods of incentive wage payment for indirect workers. Some of the larger truck makers also are paying certain types of indirect labor on an incentive basis, while activity along these lines is to be found as well in the factories of various parts and accessory manufacturers. A survey just completed, in fact, reveals a surprising amount of actual experimentation as well as general interest in this particular phase of the factory management problem.

Obvious difficulties appear in the way of applying to tool makers, die makers, maintenance and construction gangs, sweepers, window washers, watchmen, inspectors, stock room employees, shipping department workers, job and tool setters, material handling groups and loading and unloading gangs those same incentive wage payment methods which have been found so useful in stimulating output from direct labor. A few years ago, as a matter of fact, there was a general tendency to accept these difficulties as insuperable in most cases and to dismiss consideration of the idea of applying incentive wage methods to indirect labor without too serious analysis.

Gradually, however, recognition of the value of such applications—if they could be made practicable—grew upon automotive factory men until today there is scarcely an important production man in the industry who does not seem more than willing—eager in most cases—at least to discuss possibilities along this line and to learn of experiments which are going on in various other shops. This general condition of mind is indicated by a survey just completed which covered about 20 important automotive concerns, most of them manufacturing passenger cars.

In one or another of these 20 factories practically every type of indirect labor is being paid on an incentive basis. No one factory has more than a relatively small proportion of its total indirect labor on an incentive basis, but picking one practice from this factory and another from that, it becomes evident that it is possible with at least a limited degree of success to pay almost every single type of indirect worker on an incentive basis.

This does not mean that the problem has been solved.

Plans *for* Indirect Workers Application

either using or experimenting for non-productive labor

G. Shidle

Almost the exact opposite is the case. What it does mean is that experiments and practices are available for examination and discussion on almost every kind of indirect labor. Some of the methods in use by one factory do not meet with the approval of another, even where information regarding practices have been exchanged. But the indications are that the next five years will be fruitful in the study and working out of more effective, sounder and more readily applicable methods of getting indirect workers on some sort of an incentive basis.

Representative Firms Studied

The firms studied in the current survey include such representative plants as Chrysler, Packard, Oakland, Paige, Hupp, Chandler and others. The passenger car factories included in the list built nearly 50 per cent of the total output of the industry, excluding Ford, in the first half of this year. About 50 per cent of the group investigated already is experimenting with wage incentives for indirect workers, while statements from the remaining factories indicate that this total will be increased to 55 per cent very shortly and probably to 75 per cent within the next year or so.

In those plants which are paying some indirect workers on an incentive basis the proportion of total indirect labor being so paid varies between 5 and 20 per cent.

While there is pretty general agreement as to the desirability of paying indirect workers on an incentive basis, the big question which still arises in the minds of most production executives is "How Can It Be Done?"

That question cannot yet be answered with anything like completeness, but analysis, first of the fundamentals underlying the problem basically, and, second, of the experiments and efforts already being made along this line, should illuminate at least a little more this somewhat complex subject.

There are ten or a dozen different bases upon which incentive payments to indirect workers may be built. Among the chief ones may be listed:

1. Each individual job may be studied and an attempt made to devise some sort of numerical standards by which its results may be measured. (It often has been found possible to establish such standards in cases which off-hand seem almost impossible). Sometimes, however, the effort expended in setting up and operating the standard is so great as to be out of proportion to results attained through the application of incentive.
2. Indirect workers can be made members of a productive group whose product is measurable numerically. This can be done with either group bonuses or group piece work plans.
3. Indirect workers can be paid bonus on basis of total factory output.
4. Indirect workers can be paid bonus on basis of output of department or department which they serve.
5. Bonus may be paid on basis of a rating of the individual worker made by a superior as regards such qualities as productivity, quality of work, personality, interest in work, cooperation, organization, etc.
6. Bonus may be paid on basis of length of service, the reward coming, perhaps, at the end of each year for the completion of another twelve months' service.
7. Additional financial incentive may be given to indirect workers in the form of profit-sharing.
8. Stock ownership by indirect workers offers another possibility of incentive creation.
9. Department expense and production requirements may be budgeted and a bonus paid to individuals within the department — including indirect workers—on basis of results as compared with the budget.

Before discussing the advantages and disadvantages, the possibilities and limitations of each of these various methods, it will not be amiss to turn again for a moment to the fundamental requirements of any wage incentive system which is to be effective, whether it be for direct or indirect workers. This is necessary

since discussion of the points outlined can be conducted most intelligently on the basis of these fundamentals. As expressed in the article on wage incentive systems in general which appeared in our Production Issue last year, September 24, 1925, among the more important of these principles are:

1. The workman should be able to calculate readily how much money is coming to him. The system should be as simple as possible. The average workman should be able to understand it without difficulty.
2. The relation between the reward and the effort should be direct and continuous. As the output increases the reward should increase; at no point in the scale of production should the increase in reward cease—nor should it decline as rate of output increases.
3. The reward should be directly and visibly dependent on individual effort insofar as possible. Where incentives are on a group basis, the group should be small enough for the individual to feel and see very definitely the effects of his personal efforts on group achievement.
4. The wage system should take into account the desire of the management for quality as well as quantity production, for long continuous service on the part of the employee and should provide incentives for each of these factors.
5. The wage system must have the entire support of the administrative organization. The officials of the company must be sold on the psychological soundness of the system so that the spirit in which it is administered may be such as to carry out the fundamental ideas embodied in the incentive system itself.

With these principles in mind, it is pertinent to try to evaluate some of the methods of paying indirect workers already mentioned.

Psychologically, the first method mentioned is the soundest and most effective. Its advantage lies in the amount of preliminary effort needed in setting up standards. At the Chrysler factory, for example, a strenuous effort was made to put on an incentive wage basis a messenger who served four departments. It was finally arranged that this messenger should be paid a bonus based on an average efficiency of the four departments which he served, the productive workers being on a group bonus system. This method of payment was tried out for a while, but it soon became apparent that the amount of trouble necessary to pay this messenger on this basis was far greater than the increased results to be obtained from him by the bonus application. The experiment was discontinued.

Study of Individual Operations

Most of the cases in which incentive payments have been applied to indirect workers most successfully, however, have been those in which careful study of the individual operations has resulted in the establishing of some sort of direct yardstick by which the work of the indirect labor could be gaged. Setting of a standard time for loading and unloading jobs by an estimator and payment of a bonus on the basis of elapsed time as compared with estimated time, for instance, is being applied successfully in some factories, while in others these same operations have been reduced to even more fixed standards on a tonnage basis, various general types of material being grouped into specific groups for each of which a different tonnage task applies.

It is probably safe to say that a serious attempt should be made to find some means of setting up a numerical standard of some kind for the work of indirect workers before other easier—but psychologically less direct and effective—methods of providing an incentive wage are considered.

The plan of making indirect workers members of a productive group whose product can be measured numerically seems like a good one, although limited in its possible applications and containing some inherent dangers under certain circumstances. Where group piece work is being used as the general wage payment scheme of the factory, indirect workers who serve only a single group can conveniently be made members of that particular group without any detriment to the productive workers and with some advantage to them. This plan is in vogue at Packard Motor Car Co., and includes a goodly number of the indirect workers in its operation because the Packard groups for the most part consist of entire departments; that is, of units large enough to necessitate the employment of many indirect workers in the service of a single group.

How It Works at Packard

The working out of this principle at Packard is a good typical example. "The indirect workers," writes H. M. Tomkins, industrial engineer of this company, "are members of their respective groups and their hours are figured in with the actual hours on production; that is, the elapsed time, due to this indirect work, is computed at the group or departmental efficiency. As an example, if it has been determined that a department or group needs two sweepers at 10 hours a day each for 20 hours total and the department or group is working at 90 per cent efficiency (75 per cent efficiency the point at which bonus begins under the Packard plan) the elapsed time for these two sweepers is figured at 90 per cent of 20 hours or 18 hours, which goes to the credit of the departmental direct time. This would mean a 15 per cent bonus to all. By using this method and keeping only the necessary number of men for indirect labor as predetermined, we do not pay any bonus on inefficiency."

Bonus to indirect workers on the basis of departmental output is practically the same thing as payment on the basis of departmental efficiency, the only difference being in the terms in which the efficiencies are calculated. While the visibility of the relation between effort and reward is higher than when bonus is based on factory output, it is not nearly so direct as in the case of a similar method applied to direct labor.

Additional payments to indirect workers based on length of service would tend probably to decrease labor turnover, but could be expected to have only a very limited effect on quantity or quality of work, assuming a reasonably satisfactory performance to be normal.

The long distance between effort and reward is the chief objection which is raised to profit-sharing as an incentive method of paying indirect workers. This seems evident despite the very excellent arguments which may be made for profit-sharing. The general factory executive, with his background of knowledge of the whole business and the industry, may well be appealed to by profit-sharing, but to the individual factory worker, the relation between his turning out 50 instead of 25 pieces today and his receiving a few extra dollars for those extra 25 pieces three months or a year hence usually is very hazy if not non-existent. At least, such has been the experience of a good many production men, despite the success of profit-sharing plans in certain phases of the industrial structure.

The last mentioned method of incentive payment to indirect workers—that of budgeting production and expenses for a department and paying bonus on relation of performance to budget—is being worked out in one automotive plant at the present time, but since it is only now in the process of installation no accurate estimate of its results in the automotive field can yet be made.

With the relative incentive values of the different methods in mind, the application of different forms of incentive payment to specific types of indirect labor may be discussed. To cover every type of indirect worker in a single article would be difficult, but most of the more important classifications can be examined and the experimental work being carried on in connection with them described.

Tool makers and die makers are being paid on an incentive basis in several automotive plants, although more factories have found it possible to get the die room on an incentive basis than have been able to put the tool room on incentive. Generally speaking the method used is to employ an estimator, who estimates the time necessary to perform each given tool room or die job. Then the men are paid a bonus in accordance with the extent to which they manage to beat the standard time estimated.

The method worked out at Paige-Letroit Motor Co. by Joseph Lannen is perhaps the most complete experience available on this matter at present. Writing of the application of a group along the lines described to tool room workers, Mr. Lannen states:

"It is not practicable to make time studies of this type of work as is possible in production work and, at first thought, timing it would seem to be an impossibility but this was worked out by a gradual development.

"We had been estimating the cost of tools for several years and found it possible to secure tool estimators who could check up with the outside tool shop costs well within 10 per cent.

"It was only natural that after having been successful in checking up on outside tool sources that we would apply the same method to check up on our tool room. When this was done the idea of using the estimate as a basis for the development of a wage incentive for the tool room had its inception and was carried out in the following manner:

"The estimator's desk was moved into the tool room and he estimated every job coming into this department. We anticipated difficulty in estimating repair work but the problem was solved by estimating the cost of dissembling the jig or fixture to be repaired and, after the extent of the repairs required was determined, estimating the amount of work necessary to put it into good condition.

"To keep an accurate record of the time applied to each job it was necessary to install a clerk to keep time and issue job tickets. This clerk also keeps a record of the time applied to each job.

"One month after the estimator moved into the tool room the bonus system previously described was put into effect. This was in May, 1924, and it has been in effect during the 20 intervening months. The average bonus earning during this period has been 6 per cent of the wage paid. The maximum received in any one pay period was 27 per cent. Bonus was not earned during eight pay periods."

Both Packard and Chrysler have worked out incentive payments for die room workers, but have not yet applied such methods in the tool room. At Packard sufficient experience in routine die work has been accumulated to make it possible to establish standard times on many die jobs, while at Chrysler the estimator plan is in vogue.

Those plants which have worked with this plan for tool and die makers feel that the results achieved have more than compensated for the effort involved in installing the system, despite the fact that many detailed difficulties had to be met and ironed out in the process. A rather detailed explanation of how the group bonus plan has been applied to non-productive labor in the Paige-Detroit plants is contained in a paper by Joseph Dannen, read before the Society of Automotive Engineers' annual meeting in January, 1926, and published in the S. A. E. Journal of August, 1926.

Relatively little has been done in putting construction and maintenance gangs on bonus, the Paige-Detroit activities and those at White Motor Co. being the chief ones of importance along this line. In the construction division at Paige, all construction jobs are estimated by the supervisor of maintenance and the same form of bonus as is used in the tool room is applied. Practically all of the maintenance and construction work also is on an estimate and bonus system now, a plan of paying maintenance men a bonus based on total plant car production having been abandoned after adequate trial.

The White maintenance group is organized under the general supervision of the plant engineer and under the immediate charge of the master mechanic. The group includes maintenance proper, steam, air and power equipment, janitors and watchmen, yards and ways, garage, locomotive, cranes, refrigeration and general. The bonus arranged for this type of worker is on a group basis and developed so that it becomes merely another application of the Parkhurst differential bonus plan under which White direct labor already was functioning. The establishment and operation of the incentive wage to maintenance workers at White is described by R. M. Hidey, works manager, as follows, in a paper read some months ago before the American Management Association:

"We decided that because of the variety of the tasks, ordinary time study methods would be impossible. So we set out to get an estimate or approximation of their general efficiency, then to devise a means of payment in relation to the work done measured by the number of truck units produced in a given pay period.

"We proceeded in about this manner: We assigned, for example, three trained time study observers to three plumbers. On alternate days each observer recorded everything which this man did during the day. In this way we obtained three independent observations of each plumber.

30 Per Cent Idle Time

"The observers reported that on the average the plumbers worked about 70 per cent of the time. The remaining 30 per cent was spent either in idle time or in unnecessary movements.

"The procedure for plumbers was followed through for carpenters, electricians, and others to whom this method could be reasonably applied. Janitors, scrub-women and others who can be assigned definite known units to perform were not considered in the procedure because their work can be time studied by ordinary methods.

"Having determined the relative efficiency of the men in the department, our next step was to ascertain the maintenance force required for any given unit truck production.

"For this purpose we assume the plant shut down to zero production and boarded up for at least a year. Then by employing our judgment as to reasonable precautions for adequately protecting our property under these conditions, we figured out the number of men necessary to keep on our maintenance payroll. We found that we would require a force of 40 men in summer and 44 men in winter, summer officially beginning May 1 and winter beginning October 1.

"By making use of our records of different maintenance forces employed at various production schedules, we worked out a curve which gave us the man hours required for almost any degree of production. This, of course, with our men working at 100 per cent efficiency.

"Correlating all of our information, we obtained the maintenance man hours applicable to a single truck unit. Adjusting this figure again for gross plan operation figured at 80 per cent efficiency, we now had a figure which represented the maintenance man hours required to produce a truck unit, the maintenance department working at 100 per cent efficiency and the whole plant working at 80 per cent efficiency.

"With the information now available, it was a simple matter to incorporate our finding in a table which represents man hours at various efficiencies required to maintain various production schedules. This table is the basis for figuring all bonus pays.

"We now had all the information necessary to put the department on our regular bonus plan, the Parkhurst plan applying equally well to either direct or indirect departments. So on January 1, 1924, we put our maintenance department as a whole on the bonus plan.

"We regard the plan as unqualifiedly successful."

The question as to whether or not inspectors can properly be put on some sort of incentive wage basis is a live one, concerning which there is some considerably difference of opinion. The view held by a majority of automotive production men apparently is that inspectors cannot be made members of the production group with which they are working and put on group bonus, nor can they be paid on a piece work basis. The danger of encouraging the inspector to pass defective parts, to hurry his inspection unduly, or to skip inspection of some units is the argument usually made to support this contention.

Two very large and successful car manufacturers, on the other hand, have been paying their inspectors on an incentive basis for some time one a company building a car in the $600-$1000 class and the other cars in the $1500-$2500 class.

System Proves Successful

The production manager of the higher priced car company states that, "Having inspectors on piece work has worked out very well despite the fear which we—along with all others—had that the system would result in rapid and careless inspection. As we see it now, the inspectors, because they are better paid, are conscientious about their work and more interested in holding their jobs than ever before and consequently tend to improve the quality as well as the quantity of their work."

An important manufacturing executive of the lower priced car plant holds much the same view. In this case, the inspectors are paid a bonus based on the number of cars turned out by the plant each day and thus the relation between their own activity and the reward is less direct than in the previous instance. The inspectors in this plant used to be on a straight piece work bonus and the particular executive in question, as a matter of fact, believes that they should be put back on that basis.

In some cases, outside of automotive industry, the plan of putting many inspectors on an incentive plan has been successfully applied where the work of the particular inspectors on incentive later is to be inspected again by another type of inspector not on incentive. This plan in some ways seems to offer perhaps a feasible way of experimenting with inspectors on an incentive wage without taking too great a chance with ultimate quality.

A fairly wide amount of experimenting has been done in the industry in putting loading and unloading gangs on an incentive basis. Usually the basis of the wage in these cases is the tonnage handled in a given time. This is the basis at Chrysler where H. G. Perkins has been making very careful studies and experiments on the whole question of paying indirect workers on an incentive basis. Cadillac has worked out and had in operation incentive for this group for some time, while Paige-Detroit also is paying loaders and unloaders on an incentive basis. At Paige the "shipping department is paid on a piece work principle; stock room and receiving department is paid a bonus based on number of cars built."

A somewhat detailed plan for placing these groups of workers on incentive basis has been developed at the Oakland plant in cooperation with E. K. Wennerlund of General Motors advisory staff. Oakland is operating in general on the Wennerlund group bonus plan and the loading and unloading employees have been put on this plan. Feeling that the very different character and conditions of handling of various materials made a simple tonnage basis somewhat unsatisfactory, the materials to be handled at Oakland were grouped in four divisions, A, B, C and D. Any specific material is placed in one or the other of these divisions in accordance with its weight density, ease of handling, etc. Then standard times for handling have been set up for handling each of the four divisions of material.

When a load comes in the checker simply classifies it as being in one or the other of the groups. Then the unloading gang is broken up into relatively small groups, each with a group leader. The record of tons of each group is kept by the checker and the time for each man is turned in by the timekeeper. Then from the two records the accounting office determines the efficiency of the group and the pay of each individual in the group just as in the other applications of the Wennerlund group bonus plan.

Several attempts have been made, apparently successfully, to put sweepers on an incentive basis, although relatively little detailed data on this group seems to be available. Packard, of course, has put sweepers on incentive by making them members of the group on group bonus in whose department they work. Paige, according to a statement made by Mr. Lannen at the S. A. E. annual meeting last winter, "intends to put sweepers on a floor space basis, if it seems practicable to do so." When the sweepers are in a so-called productive department, Chandler has them as members of the group in the group piece work plan which it applies to productive workers. Cadillac, according to a statement made at an S. A. E. session some two years ago, "has all sweepers on bonus system and has thereby reduced that labor by 40 per cent."

The stock room has been put on incentive in several automotive plants. Unusually the basis is that of total number of cars produced by the plant, although the plan of basing the bonus of stock room workers on actual hours worked as compared with the standard hours of the departments which they serve also is in vogue.

In stock rooms, Mr. Wennerlund thinks, the purpose of incentives is to cut down the number of men necessary to employ for this work. Stock room workers should not be given an incentive plan with the idea that they will thereby be stimulated to help the productive workers more than previously; at least that should not be the primary idea. The chief reason for putting them on incentive is to give them reason to do more work and thus cut down the number of men needed in the stockroom.

One Way It Might be Done

This can be done, Mr. Wennerlund believes, by basing a bonus for stock room workers on the ratio between the actual number of hours worked by the stockroom employees and the standard hours of the departments which they serve.

Truckers and material handling workers have been put on bonus in only a few instances, usually by being made members of a productive group which they directly serve in plants already using a group payment system of some kind as its regular method of payment for productive workers. Some attempts at working out standards of achievement for individual truckers has been made, but thus far it would appear to be the concensus of opinion that the amount of effort needed to evolve such standards is greater than the results to be achieved from getting the truckers on an incentive basis.

As regards job setters and tool setters, there seems to be general agreement that these men quite properly and profitably can be placed on group bonus or group piece work as members of the productive group in those plants where some group method of payment is general. These men are on bonus in a majority of plants today, but all of those who have tried the method mentioned seem quite thoroughly satisfied with its results from practically every standpoint.

Compressed Air a Valuable Production Aid

Pneumatic tools and fixtures employed extensively in all automotive plants and sphere of usefulness is increasing as new methods are developed.

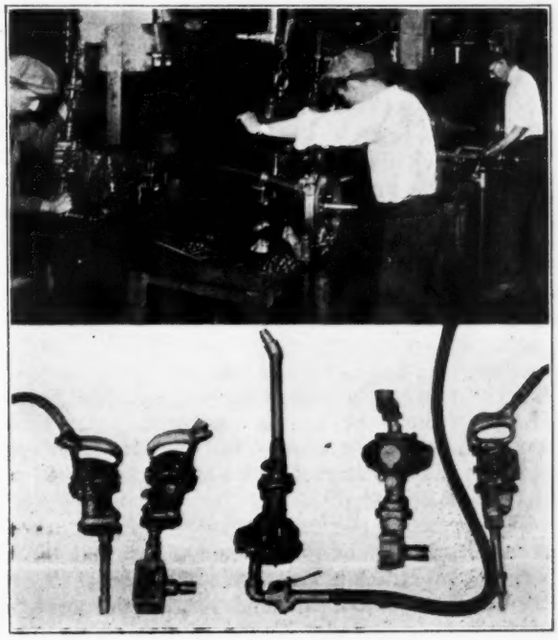
By
Maurice A. Thorne

Motor air hoist lowering an engine into position on a chassis

THE increasing use of compressed air further emphasizes the important position which this medium of power transmission has always occupied in practically every phase of automotive production. New requirements imposed by changing production conditions are met by developments which constantly add to the already diversified applications, and several recently devised pneumatic tools and fixtures have filled decided needs. Additional tools will probably be evolved for use in connection with the production of all-steel bodies, and a solution to the problem of present tedious methods of hand-rubbing pyroxylin finishes is looked for in some form of air-driven device.

Creative ability has provided many innovations in the uses of compressed air, but in general, ingenious adaptation and development of tools which existed prior to the time that automotive vehicles became a factor in transportation constitute a large proportion of application. The broad use of compressed air and pneumatic tools throughout the industry is convincing evidence that they have satisfied the conditions of economic selection in their specific spheres of usefulness.

In the large car and truck factories immense compressors provide air for the operation of tools of every description, and even in small plants manufacturing component parts, compressors and at least a few representative air tools will generally be found. From the unloading platform of vehicle plants to the point at which the finished car is ready for delivery or shipment, air and pneumatic tools play a conspicuous part in conveying and handling,



Below: Fig. 1. Air drills equipped with attachments for nut running. Above: Fig. 2. Air drills in use on final assembly, attaching springs and axles

process operations and all types of assembly work.

Mechanical simplicity and ruggedness are general features which characterize all air devices and definitely contribute to their value. They require little attention, and failures occasion few interruptions in service. The compressibility of air has been responsible for the development and adoption of numerous devices which effect controlled cushioning action and is also a generally favorable characteristic of compressed air as a power medium.

Applications of compressed air may be grouped in three classes: (1) To tools which are operated by compressed air and are generally referred to as pneumatic tools; (2) to fixtures and appliances used in connection with machine tools, etc.; (3) to "free air" operations. Typical applications in each group follow:

Pneumatic Tools

Portable drills for nut running, screw driving, drilling, tapping, reaming, buffing, grinding, polishing, etc.
Portable hammers for riveting, chipping, core breaking, etc.
Air brushes or sprayers for applying paints and protective coatings, cleaning and deoxydizing solutions.
Cylinder and motor hoists.
Cylinder jack.
Pusher conveyors.
Rivet squeezers.
Pedestal riveters.
Hammers for forging, bumping and forming.
Punch and forming presses.
Arbor presses.
Molding stands.
Sand sifters.
Sand rammers.
Sand blasts.
Vibrators.
Baling presses.
Assemblying devices.

Fixtures and Appliances

Jaw and collet chucks for lathes, drills, etc.
Expanding arbors.
Tail stock centers.
Air cylinders for operating work tables on drills, milling machines, etc.
Work holding fixtures for drills, shaping and milling machines.
Tapping spindle oscillator.
Work ejectors.
Die cushions.

Free Air Operations

Blowing chips and cleaning after machine operations; clearing machine work tables, stand and benches; drying and cleaning parts.
Tire inflation.
Testing castings, radiator cores and gasoline tanks for leaks.
Blast for rivet heaters, small furnaces and ovens.
Displacement air pumps for paint or liquid supply drums.
Solution agitation.
Metal aeration and agitation.
Source of pressure to fill die casting molds.

Brief descriptions of a few examples from the applications listed in these groups will illustrate the typical adaptability which is characteristic of practically all pneumatic tools and devices.

The drills shown in Fig. 1 are provided with attachments for nut running, designed to give easy access and facilitate the operation of attaching springs and axles as shown in Fig. 2. When used for this and similar purposes, such as setting studs in cylinder blocks or driving screws, the drills are run to a stall without injury.

There are different types of drill with many ingenious built-in features which add to their value. A large number of other attachments available for use with the drills make them suitable for numerous purposes in practically every department, and particularly they are in evidence on final assembly lines. The saving in time and effort is obvious. In addition, operations are accomplished with a high degree of uniformity, as the strength or physical condition of the operator when working with a power tool is a much less important factor than in more tedious manual tasks.

Frame riveting, shown in Fig. 3, illustrates one use of the pneumatic hammer. This tool, as in the case of drills, has earned an important place in the industry. It is employed to the greatest extent in the factory, where, equipped with different heads or bits, it is utilized for breaking cores and chipping castings preparatory to grinding. In its modification as a sand rammer, the air hammer has been displaced to some extent by pneumatic molding stands which effect the operation more rapidly, but new applications are constantly being made which more than offset this change.

Air Brushes in Paint Work

Air brushes have been used extensively for spray painting (Fig. 4) for a long time and with the advent of pyroxylin finishes the number in use increased many times. If any tool used in the industry may be termed indispensable, this one has most claim to the distinction. From a production standpoint it is difficult to visualize an acceptable substitute. The final rubbing of these finishes is accomplished manually at present and is subject to the disadvantages of such methods. Some form of air tool is looked for and would be a welcome solution to the problem.

Fig. 5 shows an air hoist of the cylinder type in the shop of the Jones & Lamson Machine Co. The hoist is mounted on a swinging jib crane and is used in connection with the operation of scraping the saddle to the bed of one of the company's flat turret lathes. The task of alternately removing the saddle for scraping and replacing it for spotting is greatly facilitated by the hoist. This is one of hundreds of different applications. An air motor hoist is shown on page 549 lowering an engine into place on a chassis. These and various modifications of the two types illustrated are an important factor in the problem of material and parts handling. Valves and special features permit very accurate control of their speed and travel.

Between two and three years ago the pneumatic pusher made its appearance and became popular immediately, particularly in body and paint shops. The pusher and its application to a body storage line, illustrated in Fig. 7, was described in *Automotive Industries* of September 24, 1925. Each body is mounted on a wheel car which is guided by a channel. The pusher operates a long bar with carrying dogs which engage the frames on the carriers. Operation of the valve at the pusher advances each of the carriers one stage, while reversal of the valve returns the pusher bar to position for the next stage of advance. The pusher has found rather liberal application of the simple drying booths for pyroxylin finishes.

The air cylinder is the basic element in the design of many valuable air tools and fixtures. The pneumatic press in Fig. 8 is shown forcing a valve stem guide into place in a cylinder block. A shoulder on the shank of the tool automatically and accurately gages the location of the valve guide in the block. Twin punches (Fig. 9) are being used to punch holes in a dust drop for the attachment of a kick plate. In the case of both machines, accuracy is assured and speed is dependent mainly on the operator's rapidity in loading.

The turret head riveter shown in Fig. 10 is one of a line

of pneumatic riveters developed for cold riveting chassis frames. The shapes of the four noses and arms on the rotating turret head are such that they conform to the space available at various rivet locations. Movement of the die and the index pin which locks the turret head when any of the four noses are in alignment is accomplished by air. Fifty cycles a minute are possible with the tool. The illustration shows a Cadillac frame which requires 208 rivets, all but 25 of which are placed by this or other modifications of the riveter. These tools are excellent examples of the idea carried out in automotive production of fitting the tool to the product, rather than limiting the design of the product to operations that can be performed by existing machines.

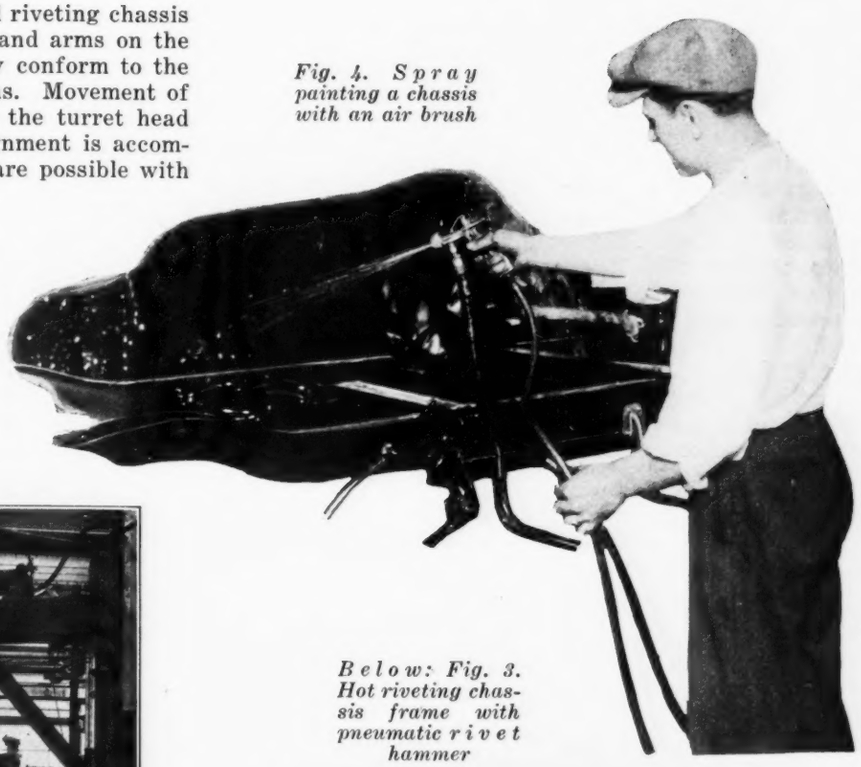


Fig. 4. Spray painting a chassis with an air brush

Fig. 5. Cylinder hoist bracket on the arm of swinging jib crane

Below: Fig. 3. Hot riveting chassis frame with pneumatic rivet hammer

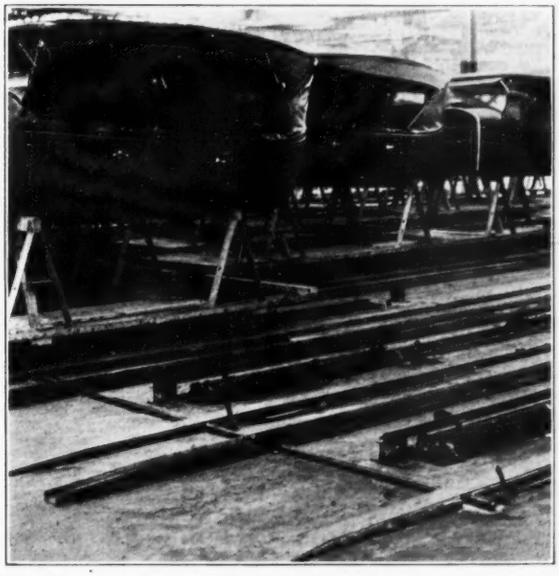


Fig. 7. Pneumatic pusher conveyors on body storage lines

A Gaterman pneumatic oscillating tapper, shown in Fig. 11, is being used to tap stud holes in a cylinder block. The pneumatic element of this tool provides a sensitive means of adjusting for tap resistance so that the tap is automatically oscillated or backed off slightly when the torque increases beyond the pre-determined limits.

Air operated chucks and work holding fixtures of many different types have been employed for years and are used in connection with a variety of machine tools. The turret lathe shown in Fig. 12 is fitted with two air operated chucks which materially contribute to the high production capacity of the machine. A Milwaukee miller fitted with

an air-operated fixture which holds four pieces is shown in Fig. 13. An air valve is automatically operated as the reciprocating slide, on which the holding fixtures are mounted, travel back and forth. Thus the work pieces in two stations are released and are then available for reloading as the work pieces in the other two stations approach the cutter.

Uses for free air are innumerable and in nearly all plants outlets and hose lines are conveniently located for such purposes as blowing chips and cleaning machine worktables, as illustrated in Fig. 14. The requirements for blowing are by no means small and will frequently consume 25 per cent of all air compressed.

While the foregoing descriptions have been necessarily brief, and only a limited number of applications have been touched upon, they will serve to indicate the obvious importance of compressed air and pneumatic tools in the present scheme of automotive production. They have contributed decidedly to increasing production output and the quality of the product. Past needs have been met by the developments of highly satisfactory tools. New requirements are constantly arising, such as those created in connection with the production of steel bodies, and it is confidently predicted that they will be equally well met in the near future by the development of many new air tools.

Fig. 10. Frame assembling with a turret head rivet squeezer

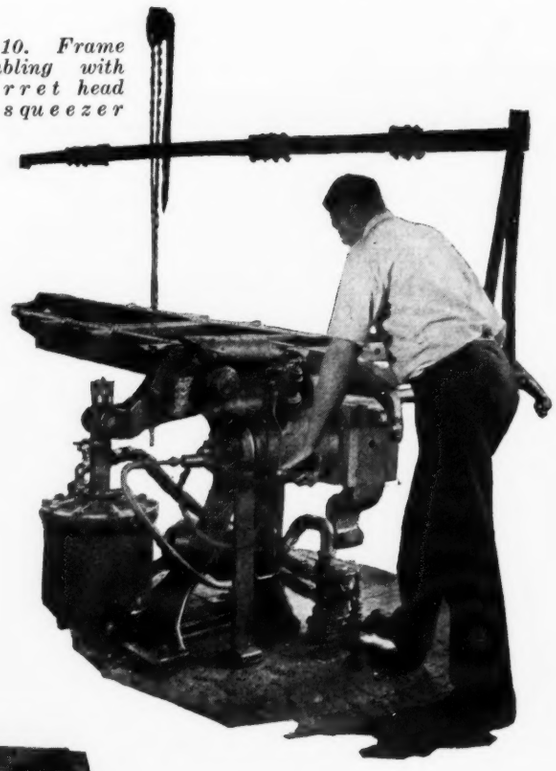
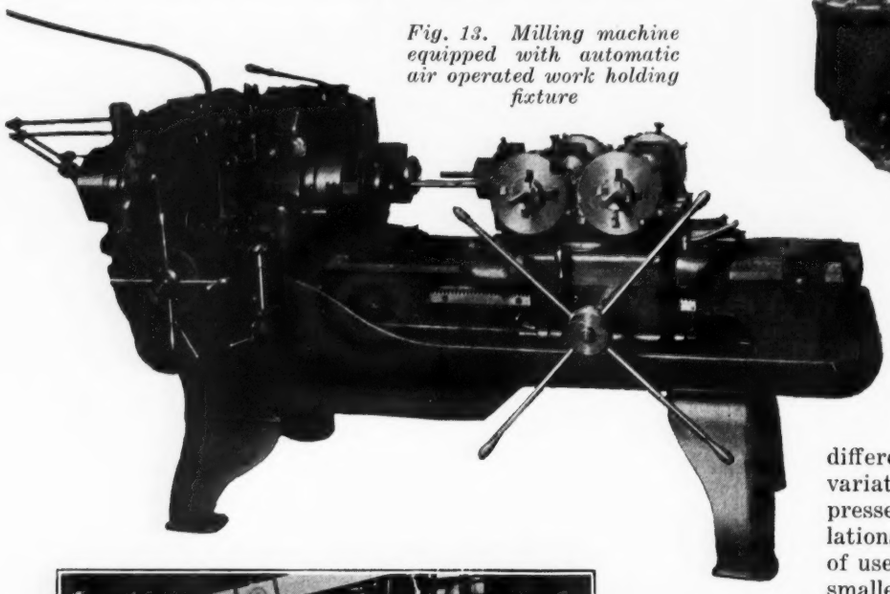


Fig. 13. Milling machine equipped with automatic air operated work holding fixture



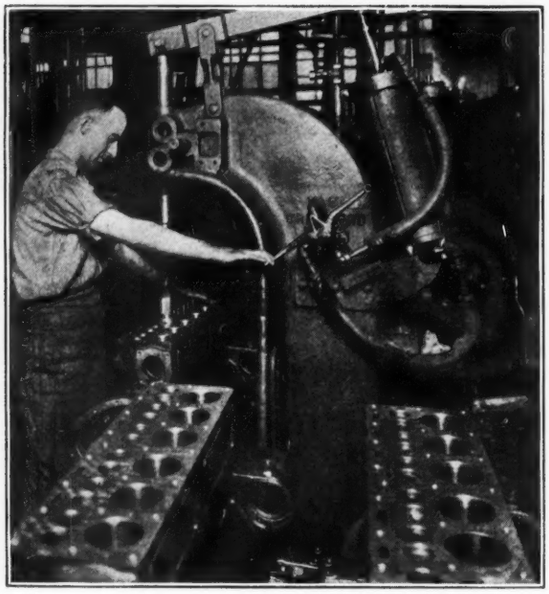


Fig. 8. Pushing valve stem guides into place by means of an air press

Compressor installation practice in different plants is subject to considerable variation. Where the requirements for compressed air are large, central station installations are general with supply lines to points of use. In a few plants compressors, usually smaller units, are installed in departments or locations where the need arises. There are advantages in favor of each type. Department compressors probably provide greater flexibility in the event of a change in layout and eliminate some of the complexities of transmission which in automotive plants is a greater problem than in most other industries, owing to the type of buildings and consequent wide horizontal spread. On the other hand, the labor required for operation and care may be somewhat greater.

A large proportion of compressors are driven by electric motors, though high and low pressure steam engines also are utilized to a great extent. Among numerous improvements in compressor design which have been made in recent years, the development of light automatic valves is notable. These valves have made higher rotative speeds possible, thus allowing the use of direct-connected synchronous motors, and in the case of steam drive, of operation at more efficient speeds. Resulting economies have appreciably reduced the cost of compressing air. When driven by steam engines, the exhaust steam is frequently utilized for heating purposes.

Practically all tools are designed to operate on pressures between 80 and 100 lb. per sq. in., and line pressure, therefore, is customarily maintained between these limits. In instances where lower pressures are required, tools or attachments are equipped with automatic reduction valves or valves are interposed in the line which permit manual control.

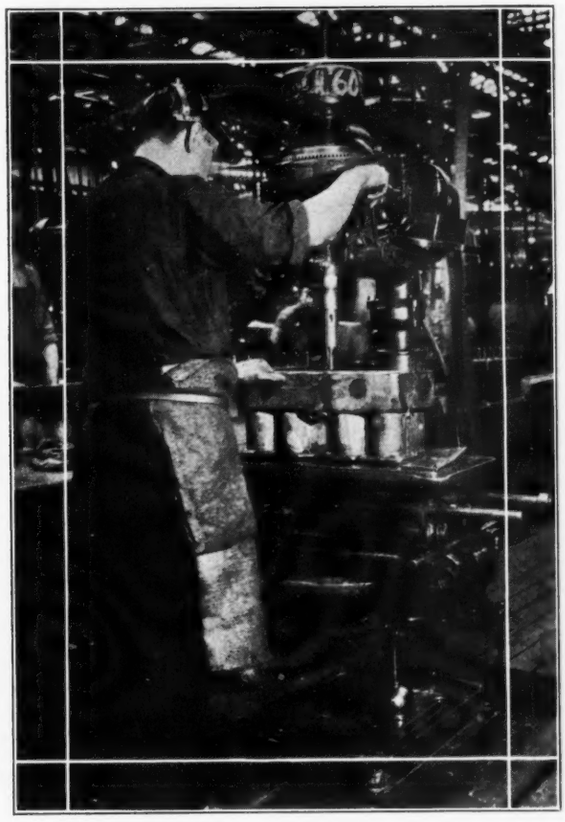


Fig. 11. Pneumatic operated tapping machine

Higher efficiencies obtainable with two-stage compressors is responsible for the nearly universal use of this type in any but small sizes. Air washers are used infrequently, as care is exercised in locating the air intake with a view to minimizing the dust content. Some provision for removing water, either by after-coolers or moisture traps, is usually essential as otherwise paint jobs might be spoiled or trouble caused through rusting of tools. The likelihood of water freezing in transmission pipes or tools is remote, owing to the temperature maintained in the shops.

The addition of tools and resulting reduction of working pressure does not necessarily require immediate expansion of compressor facilities, but it ultimately calls for the installation of additional units. The compressor capacity which may be needed for new departments is estimated either on a basis of the requirements for a similar group of tools or upon the total air consumption of tools which are to be utilized. This may be briefly illustrated by an installation that was recently effected. Production plans for a final assembly line called for 100 air tools, mainly air drills for nut running. The average consumption of the tools of all sizes was 30 cu. ft. of free air per minute. With all tools in simultaneous operation, the required capacity would have been 3000 cu. ft. Previous experience, however, had demonstrated that even under limiting conditions of maximum production, not more than 50 per cent of the tools on a line were in use at the same time. A 2500 cu. ft. unit was therefore installed, which assured a comfortable margin for the addition of more tools should the need for them arise.

THE used car problem is confronting automotive dealers in Argentina for the first time. It is stated that up to the close of 1925 the question of used cars presented no serious difficulty but during the present year this problem has received serious consideration. It is estimated in Argentina there are approximately 175,000 passenger cars in operation, of which 100,000 are less than two years old. Only three or four dealers will take in used cars and the disposition of trade-ins is therefore left to the would-be purchaser of the new car.

Fig. 9. Punching holes in dust drop for kick plates by means of twin punches

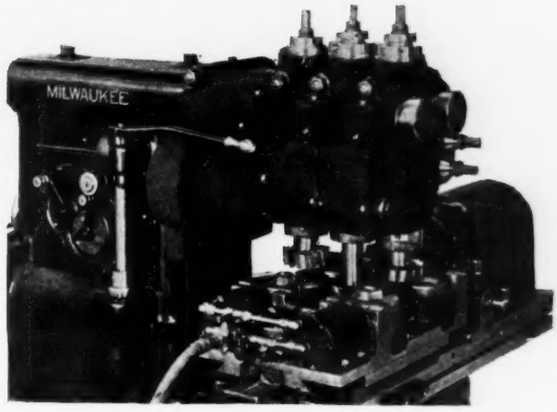


Fig. 12. Air chucks on turret lathe

Fig. 14. Air lines conveniently located for blowing chips

Effective Ways to Perform 17

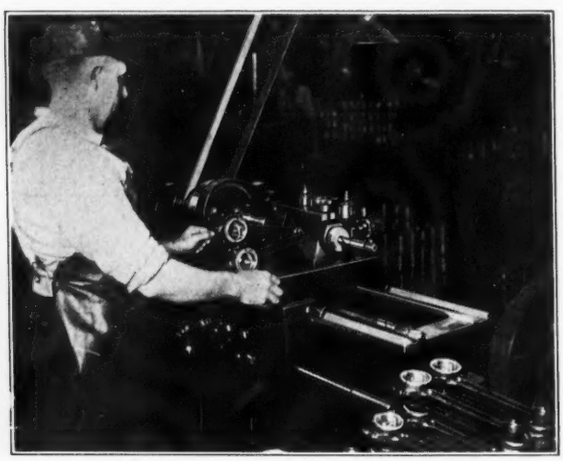
1—Piston Rod Bushings Diamond-Bored in Pairs

WHILE diamond boring of bronze bushings in the upper ends of connecting rod bearings has become fairly common, Nash has carried this operation a step further by using two opposed diamonds in one bar and boring two bushings simultaneously. While the advantage of the doubled production rate is obvious, it is stated that accuracy is improved by the balancing action of the opposed diamonds.

As shown in the accompanying illustration, a short, heavy fixture is mounted on the carriage of a speed lathe. As the rods are wider at the big end than at the upper end, they are set at different angles in the vertical plane so that the span between the pilot bushings at each end is reduced to the minimum. At the beginning of the operation, both pilot bushings and the diamond boring bar are clear of the fixture.

Two rods are placed in the fixture, as shown, being supported by vee blocks which contact with the ends of the bushings which extend beyond the forgings. Then an equalizing clamp secures the rods and the boring bar is inserted so that each of the two opposed diamonds is in the correct position to begin operation on each of the bushings. The pilot bushings then are inserted and the carriage is advanced toward the headstock until the driving mechanism for the bar is engaged. The bases of the fixture forms a pan and a pump circulates machine oil as a coolant during the boring operation.

The bar is rotated at 1000 r.p.m. with a feed of .0015 in. per rev. Limits for the operation are plus or minus .0002 in. The value of diamond boring bars is explained in the statement that as high as 38,000 holes have been bored to these limits in one dressing of the diamonds.



Diamond boring two connecting rod bushings at one operation

THE articles on these and the succeeding pages deal with a variety of special production operations as performed in different automobile plants, or developed by manufacturers of automotive supplies for the purpose of reducing the car builder's production costs.

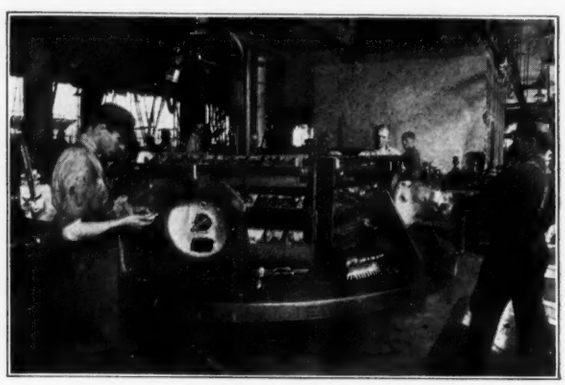
In collecting the material an effort was made to select operations which are somewhat unusual in character and which have been found to solve some particular

2—Turntable Gearbox Assembly at Cadillac

THE problems of parts storage, space economy and convenience of work are solved by a rotating assembly bench which is used in the transmission department of the Cadillac Motor Car Co. As shown by the illustration, a circular table is mounted on standards equipped with casters. In the center of the table is placed a hexagonal tower, the sides of which form bins for bolts, nuts, gaskets and other small parts required for the assembly of the gear case.

Each of the sides of this hexagonal tower faces an assembly fixtures which is mounted on the top of the table proper. These fixtures are the angle plate type and are arranged to swivel to various positions for the greatest convenience.

While all of the small parts are carried in the tower, the larger parts such as gears, spline shafts, etc., are located at various stations to which the turntable is indexed. Operations are divided and specialized to equalize assembly time at each sta-



Six transmissions are assembled progressively and simultaneously on a turntable

Automotive Production Operations

production problem in an extremely effective way.

Each article is accompanied by one or more illustrations of the particular operation discussed.

Production men who are on the lookout for new and better ways of doing things will find here a number of valuable suggestions, some of which can, perhaps, be adapted advantageously to their own manufacturing needs.

tion. As a gearset is assembled it is picked off at the final station and transported to a silent room via an overhead monorail.

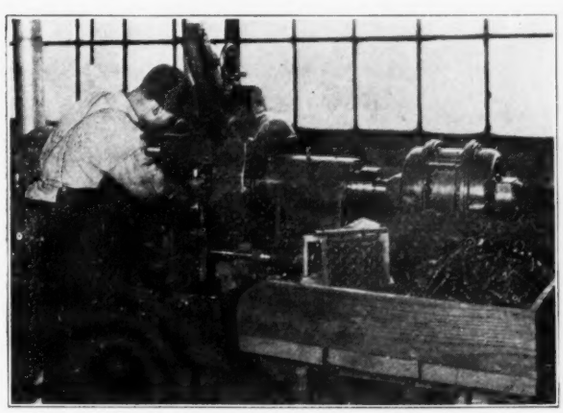
This assembly bench is located at the end of the gear case line so that no trucking is involved in the handling of the major member of the assembly. Six assembly men can work simultaneously with all stock and other requirements immediately at hand. Floor space is held to a very small area and handling is simplified.

3—Grinding Coil Springs in High Production

A GARDNER grinder equipped with hydraulic feed for the grinding wheels which are driven by individual motors is used for grinding the ends of coil springs in high production. As shown in the accompanying illustration, 20 spring ends are ground simultaneously by the use of a simple hand-operated carrier The carrier consists of a rectangular framework, the base of which is fitted with a groove that engages with a slide for the purpose of location between the grinding wheels.

Near the top of the rectangular framework is located an adjustable bar which bears down on a cluster of 20 short tubes. Each spring is placed within a short tube which acts as an individual carrier.

In operation the wheels are spread by means of the hydraulic feed, the loaded fixture is placed on the slide and moved inwardly. The wheels are then brought up gradually by the hydraulic feed and contact with the spring ends until set stops are reached. Two similar fixtures are used to reduce idle machine time. Due to the use of separate tubular carriers, individual rotation of the springs is made possible. Therefore the ends are ground off squarely.

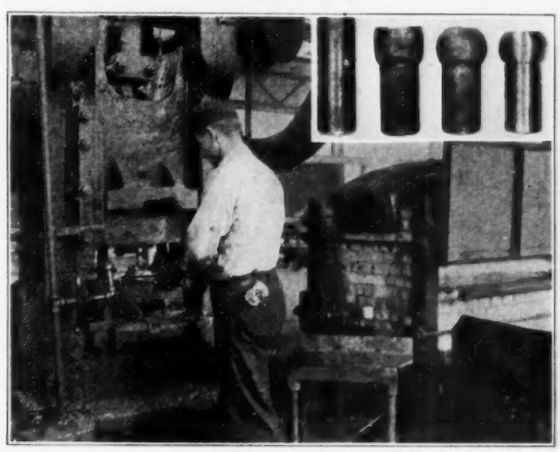


The coil spring grinding machine

4—Producing a Dodge Front Engine Support

A HOT pressing operation which incorporates simple but ingenious tooling produces the ball end which forms the front support of the Dodge engine with very little loss of material and a low labor charge.

Blanks which are cut from cold drawn seamless steel tubing are heated in a gas furnace and then passed to the operator in a pressed steel trough. The press operator grasps one end of the hot tube section with tongs having a vertical grip and places the tube in the left side of the lower die. The



Hot pressing ball ends for Dodge engine support. Insert: Four stages of ball end production

lower portion of tube section fits snugly in a cylindrical seat while the cup forming that portion of the ball nearest the shank of the tube projection is formed near the surface of the die.

The ram carries a ball end which extends into the blank and enlarges the tube as it reaches the bottom of the stroke. At the same time angle slots in the upper die contact with short hooked levers which are mounted in the lower die so that hot tube section is held until the ball end on the ram is clear away. Then springs retract the hooked levers, leaving the work clear and the operator knocks the piece out by striking a knockout lever with his tongs. This lever is shown immediately under the tongs in the illustration.

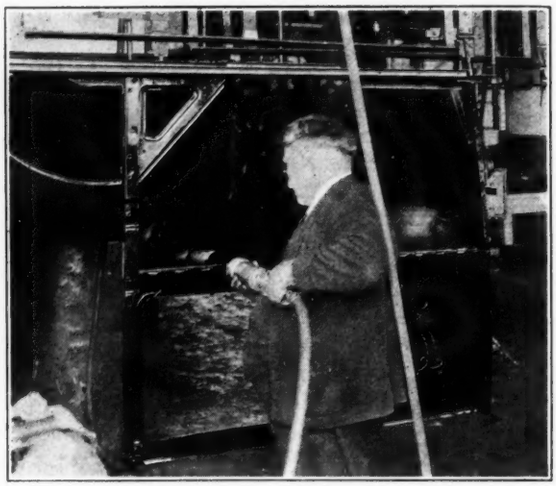
Then the operator transfers the partially formed blank over to the formed depression at the right side of the lower die which supports that portion of the ball which is made in the first operation. In the routine of the operation, he first removes a finished blank from the right side of the die, then makes the transfer and also inserts a new tube section in the left side of the die. Stepping on the treadle then brings the ram down again and a cup in the right side of the upper die closes in the upper part of the enlarged upper end of the tube and completes the ball end. A knockout lever similar to that at the left side of the die is used for knocking the finished piece out of the right side of the die.

The insert shows the sequence of operations. At the extreme left is shown the tubular blank, next follows the result of the first operation with the lower half of the ball formed, then the completed ball at the end of the press operation follows. The finished piece after the machine operations is shown at the extreme right. Production at the press is at the rate of 240-250 pieces per hr.

5—Novel Metallic Joint Used on Essex Bodies

IN the new Essex coach bodies welding is eliminated and joints are made between various body components by the liberal use of bolts and rivets. In addition to these features the method of attaching the belt beading is unique. This operation is illustrated by the accompanying photograph. Narrow metal projections are rolled back by means of an air hammer as the rear quarter panel assembly is carried along on an overhead conveyor. While the upper and lower sections are attached to the frame work at each end, it is also necessary to attach the bead firmly in a way which will prevent creaking and the possibility of working loose.

These long light steel section beads are made with several narrow projections which resemble the old fashioned type of staple paper fastener. These projections extend through the joint formed by the flanges on two body components. In the next and final stage of this particular assembly, a special air hammer is used to roll the ends of each of the projections outwardly and towards the rear in approximately circular form. In this way the extreme end of the projection is bent around so that it bears on the inside of the flange at the junction with the inner surface of the panel proper. Due to the form of the rolled bend and the cold working of the metal, the resultant clamping action not only fixes the bead snugly in place but assists in drawing the body panels together.



Rolling beading on the Essex coach body

6—Special Forging Blanks Reduce Finishing Costs

WHILE the illustrations shown herewith do not deal strictly with an automotive operation they show the product of a development in the semi-finished material field which has had a pronounced effect on costs in some automotive plants. These are illustrations of rolled forging blanks as they leave the plant of the Witherow Steel Co. of Pittsburgh. Fig. 1 shows an axle shaft which is ready for the machining operations and Fig. 2 is an etched cross section of the same shaft. Figs. 3 and 4 are blanks for reversed Elliott and Elliott type front axles respectively, while Fig. 5 shows a blank for a steering arm. Fig. 6 shows a camshaft blank. These last four are shipped in this form to the automotive forge shop where they are heated and struck for the finished form with but very little flash or necessity for breakdown operations.

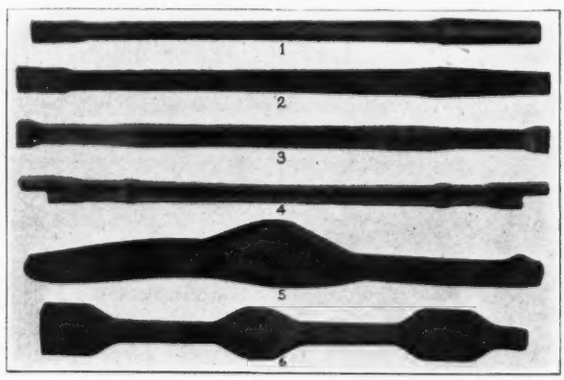


Fig. 1. Rear axle shaft rolled by Witherow process. Fig. 2. Etched cross section of same shaft showing well marked longitudinal flow lines. Fig. 3. Blank for reversed Elliott front axle requires only finish striking. Fig. 4. Elliott type axle blank ready for final operations. Fig. 5. Steering arm forging blank. Fig. 6. Camshaft blank ready for finishing dies

All of these parts are products of a special rolling process which has been developed by the Witherow Co. Stock starts as a heat treated billet which is again heated and broken down in from 7 to 11 passes through a special rolling mill. Practically all scale is removed in this operation.

Following the breakdown operation, the leaders are entered into a special Witherow forming mill and are rolled into bars containing anywhere from 20 to 40 blanks, depending upon the size and length of each piece. These bars then are passed through one of the largest annealing furnaces in this country.

After annealing, shearing and trimming produces the blanks in the finished form. Finally each piece is inspected carefully. The high quality of the structure of the die-rolled blank is shown by the flow lines in the etched shaft, Fig. 2.

7—*Economy of Material in Valve Production*

UNUSUAL economy of material is the outstanding feature of poppet valve production at the plant of Dodge Brothers, Inc. The material is chrome silicon steel which enters the plant in drawn rod form of a diameter somewhat larger than the finished size of the stem and is sheared to rough length.

An electric furnace is utilized to heat only the head end of the blank before a heading operation in a National forging machine. The blanks are placed on a metal shelf which is adjacent to a long narrow horizontal opening in the furnace into which a short section of the blank extends. Tongs are used to transfer the heated blank to the forging machine which has a moving die and strikes four blows to produce the rough blank. The forging machine is shown in Fig. 1 with the electric furnace.

Fig. 2 shows the cycle of the valve production. At the extreme left is the sheared blank. The next three views show the preliminary gathering operations and the fifth is the rough-headed valve. The sixth view shows the semi-finished valve after leaving a coin press operation as shown in Fig. 3 which shows the Hamilton coin press and electric furnace. Heating practice here follows that of the upsetting operation. The relatively cold valve stem drops down into the die and the head is compressed in a formed space between the upper and lower die. This operation produces the finished surface of the radius underneath the head and removes the slight flash which develops in the upsetting operation at the forging machine.

Two grinding operations follow, a stopped centerless grinding operation on the stem and then the stem is held in the collet while the top of the head and the seat are ground. The view at the extreme right shows the finished valve with the lower end ground to finished length, the hole drilled for the valve spring cup pin and grinding slot in the head.

The remarkable economy of material is evidenced by the average weights of the blanks from the sheared rod through the coin press stage. The average weight of several blanks in each stage varied but two or three grams from 162 grams with no appreciable variation at any stage. Completely finished, the weight is approximately 130 grams.

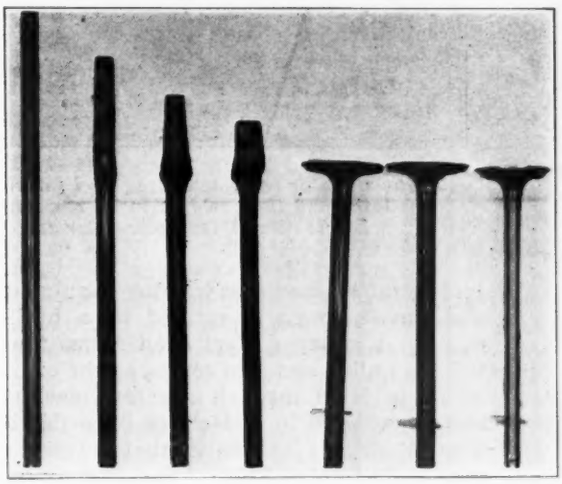


Fig. 2. Seven stages of Dodge valve production

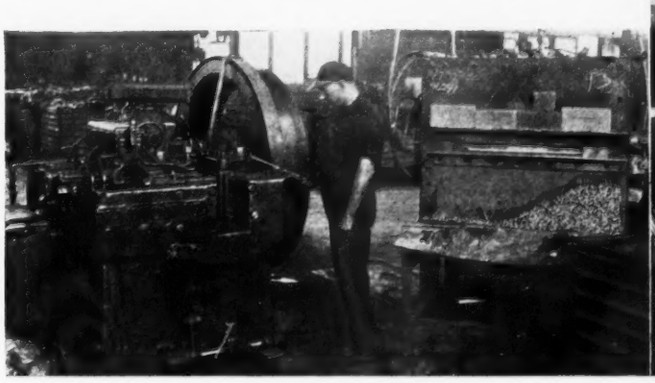


Fig. 1. Electric furnace and National forging machine where Dodge valve blanks are heated and heads upset in four stages

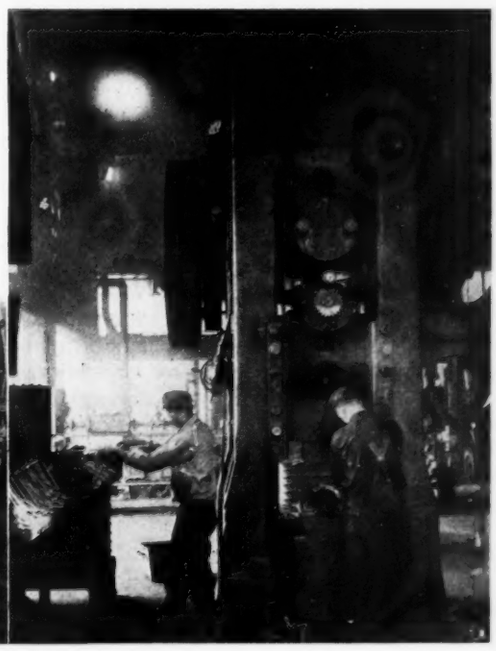


Fig. 3. Finish heading Dodge valves in Hamilton coin press

8—Combined Operations Performed on Fan Hub

TWO novel operations which apparently are unrelated are handled by one operator at the plant of the Automotive Fan & Nearing Co. of Jackson, Mich. This company makes a fan which

One operator faces and bores steel fan shells in lathe and then solders in oil connections at the rate of 1800 pieces per day

incorporates a cast iron bearing running on a hard steel shaft, being lubricated by a built-in gear pump. A stamped steel shell forms the body of the fan pulley and also serves as the oil reservoir, which is filled through a screw machine fitting that is soldered in and closed by a flat head machine screw. It is essential that the steel shell run true at its face and barrel and that an opening in its back closely fitted and concentric with the fixed fan shaft.

Experience has demonstrated that production cost is less and quality is better when inspection of the shells for concentricity and trueness of flanged face is supplanted by a truing operation in a lathe. A Warner & Swasey No. 4 turret lathe is equipped with a collet chuck which grips the barrel of the stamped shell. In order to insure the best location in the collet chuck, loading is accomplished by a dummy carrier on the turret which resembles a ball bearing center.

The shell or cup is placed over the pilot and then inserted into the rotating collet chuck. When the collet is closed, the turret is indexed to bring around a boring bar which extends into the shell and trues the hole at the back. Simultaneously, a tool on the cross slide faces off the flange of the shell. When withdrawing the boring tool which follows the ball bearing loading fixture, the operator flips the turret to bring the loading fixture around to the front of the machine. A spring plunger pushes the shells out of the collet as the chucking lever is released.

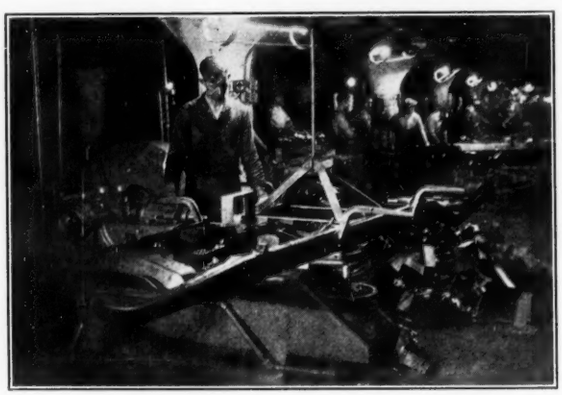
These parts are passed through the turret lathe in lots. The same operator then solders in the oiling connections at a special table fixture located at the right end of the lathe. As shown in the accompanying illustration, an ordinary steel work table carries a four armed rotating fixture and two gas jets are arranged to bear on the positions in the foreground. In the cycle of operations, the fixture is loaded at the position at the operator's left. Loading consists of placing the shell on a carrier, inserting the small tubular fitting into a hole in the periphery of the shell and applying acid with a brush. Then the fixture is indexed through two positions where gas burners apply localized heat. Finally the shell comes around to the position facing the operator where he applies the end of a roll of coiled solder which carries its own flux to the joint between the fitting and the shell. The brief period between indexing from this station to the first or loading point is sufficient for the joint to set. The shell then unloads on to a slightly inclined trough which allows cooling before delivery into a tote box.

In spite of the wide difference in the character of these operations, one man turns out 1800 pieces in a nine-hour day.

9—Horizontal Press in Frame Assembly Line

FRAMES for the Pontiac six-cylinder car are assembled in a continuous line from stamped members which are shipped into the plant. Side members and the principal cross members are brought together at the head of the line for the first stage of assembly. Transportation to subsequent primary assembly operations is effected by an overhead monorail, the carriers being equipped with extension hooks and special balancing adapters, as shown in the accompanying illustration.

An interesting feature is the method for attaching step brackets and the battery carrier. Two



Riveting step brackets and battery carrier to Pontiac frame

Bliss No. 24 horizontal presses equipped with air cushions are lined up with the overhead conveyor so that a slight pull at the frame will bring the side member over into the jaw of the press. Then the step bracket is held in place on the frame by the operator and the rivets are inserted one at a time. The operator trips the press with his foot and the rivet is pressed home.

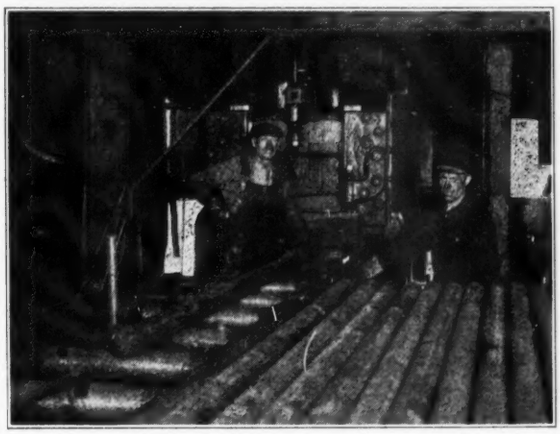
In the illustration, the second press is shown, the first being located on the near side of the conveyor. The battery box carrier of stamped steel construction is attached at one end by the same rivets which pass through the front step bracket. Rivets of 5/16 in. diameter are used for all step

brackets and are cold headed. Due to the use of the air cushion, which is connected by a reducing leverage to the cup which supplants the dolly bar of hand riveting operations, a satisfactory squeezing action is set up although but one stroke of the ram is utilized for each rivet. The slight deflection of the cup which is backed up by the air cushion causes the maximum pressure to be applied for an appreciable interval. Therefore the rivet is headed up snugly and expanded into the full diameter of the holes.

10—*Cutting Forging Stock at Continental Plant*

A RATHER simple layout of roller conveyor and shearing press facilities cutting off bar stock before the forging operations at the Muskegon plant of Continental Motors Corp. The bar stock is deposited on a high steel rack which is in plane with a heavy roller conveyor which in turn lines up with the jaws of the shear. The shear is one of the largest used in the industry and is capable of cold shearing the largest stock which goes into the forge shop of this engine plant.

As the jaws of the shear are high, the cut-off stock slides down to skids that are picked up by electric trucks and delivered directly to the hammers. While the layout is relatively simple, the high stock rack in line with the roller conveyor and shear jaws eliminates much of the cumbersome handling which is evident at some shops in the industry.

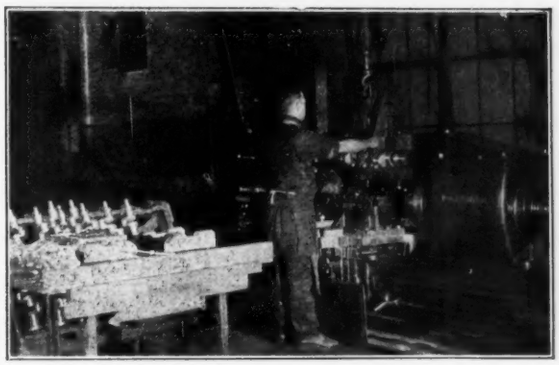


A high steel stock rack which is in plane with a roller conveyor and the jaws of a cold shear simplifies preparation of forging stock

11—*Special Steady Rests Speed Crankshaft Turning*

INCORPORATION of special steady rests on crankshaft turning lathes has enabled the Packard crankshaft department to increase production to a striking degree, and at the same time show a labor saving equivalent to 15 or more men per day.

A typical cheek turning operation is shown in the accompanying illustration, in which the operator is lowering a shaft into place between the centers of a Lodge and Shipley double end drive lathe, which is standard equipment in this department. The line bearings of these shafts are spot



Special crankshaft steady rest used by Packard

turned to accommodate the bearings of the steady rest. Two of these steady rests are used so that one is loaded while the other is in the lathe. The steady rest is located by tongues and grooves on a heavy cast bridge member which is supported by the heads of the lathe. Hinged bolts are swung into place to secure the steady rest.

In the illustration, three bearings at the center are carried in the steady rest and are secured by two bolt caps. This arrangement permits the turning of all the cheeks at both ends at the greatest rate of speed and feed with none of the troubles which arise from chattering, crankshaft deflection, etc. Tool heads move in from the front and back and are equipped with coolant manifolds which deliver a liberal flow to each individual tool.

Milling Operations

WITH the trend away from specialized machines which has characterized the bulk of the industry during recent years, the milling machine has taken on increasing importance in all new equipment schedules. While the special machine output is growing, due to the activities of the very large producers, the middle class which comprises the majority of the shops in the industry is utilizing modern developments in the milling machine field for work which at an earlier date was thought to be limited to special equipment.

Today the standard milling machine is absorbing most of this work and credit is due to its manufacturers for their progress. A machine which is fully standard and capable of handling a great range of operations is, by the mere process of adapting special fixtures or the addition of relatively inexpensive heads, made into a highly productive cyclic machine.

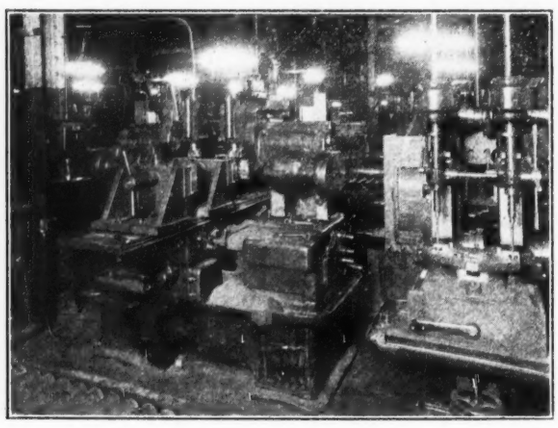
On the following pages are grouped some typical operations which show some of the most recent applications of milling machines to production work.

12—Milling of Flywheel Housing Surfaces

AN unusual cycle of operations characterizes the milling of a flywheel housing mounting surfaces on a Brown and Sharpe No. 37 Automatic Duplex milling machine. Angle plate fixtures equipped with quick action clamps controlled by handwheels are mounted on one end of the table. In conjunction with special heads which carry vertical spindles in addition to the standard horizontal spindles, the pan joint faces, mounting faces and shoulders are milled by four shell end mills.

In the regular cycle, the operation starts with the table toward the front as shown by the illustration. Both figures are loaded and the machine is started. Rapid traverse advances the table with the fixtures toward the cutters and then checks the speed to the cutting rate as the first fixture is approached. After sweeping the surfaces of the first flywheel housing, set stops on the table engage the rapid traverse again until the second set of surfaces are in close proximity to the cutters, when the speed is reduced to the working rate again. While the cutters are in operation on the second casting, the operator unloads the first fixture.

When the second casting has been milled, set stops return the table to the original position and stop the machine while the operator reloads the first fixture. The machine again is put into operation and the operator unloads and reloads the second fixture while the first is in operation.

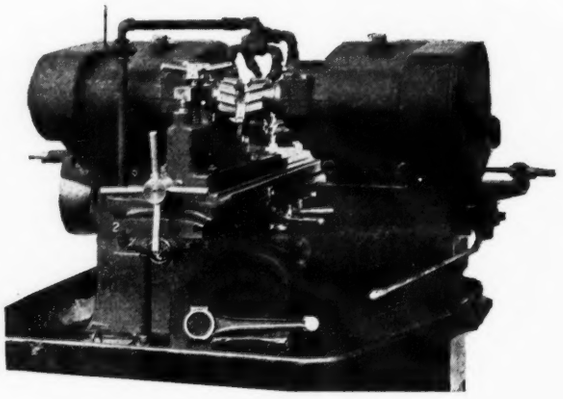


Set-up for milling flywheel housing mounting surfaces on Brown & Sharpe machine

In this cycle, the cutters rotate in the same direction while in operation on the work in both fixtures and the possibility of variation in the dimension from the pan face to the surface of the shoulder is reduced greatly. All bearings are loaded in the same direction while either fixture is in operation.

13—Straddle Milling Both Ends of Connecting Rod

BOTH ends of a connecting rod are straddle milled simultaneously in a Cincinnati 24 in. Duplex automatic milling machine which is equipped with two special two-spindle heads. Although the fixture is relatively simple and holds but one rod at a time, the production rate is 75 pieces per hr. As shown, one pair of opposed spindles is diagonally below the other pair and the rod is inclined in the fixture so that both ends can be milled simultaneously without any necessity for passing the cutters for one end of the rod across the opposite end. The position of the main spindles is set by adjusting the location of each head laterally while the spindles at the front are provided with adjustment at the quill. All four shell end mills of 4½ in. dia. are rotated at 75 r.p.m. and the feed is 7¾ in. per min. The speed of the operation is set by the time required to sweep the big end of the connecting rod. The material is heat treated drop forged steel of usual connecting rod quality.

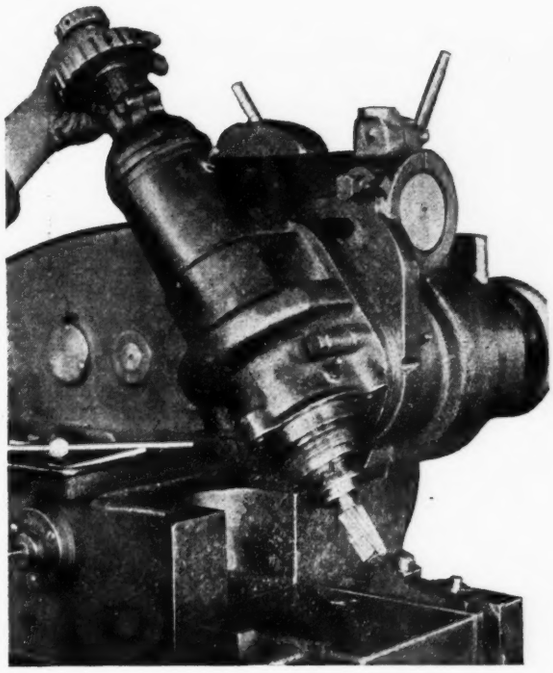


Straddle milling operation on connecting rod

In the fixture design particular attention has been devoted to facilitating the work of the operator. The hand wheel at the end of the table operates the guided vee bar clamp to secure the big end of the rod at the bolt bosses. The small end is held in a vee seat which is part of an equalized support. During loading the upper end of the rod is guided by a spring actuated plunger which incorporates a steep vee guide. This member in conjunction with the vee support for the bolt bosses insures correct location in the fixture. The equalized support of the upper end prevents twisting or buckling the rod. Operation is facilitated further by stops which control the automatic traverse, cutting speed and return to the loading position thus making this practically a special cyclic machine.

14—Duplex Miller Useful in Tool and Die Field

WHILE the operation shown in this illustration is not an automotive production job it illustrates the possibilities of a Van Norman Duplex milling machine in the tool and die field. The spindle of this machine is mounted in a head which can be rotated through 180 deg. and therefore can be utilized as a vertical miller, or, with an outboard bearing or center, as a horizontal miller. Obviously any intermediate angle of operation is available. This spindle is mounted on a ram allowing the cutter to operate close to the column



Van Norman Duplex milling machine

or at a considerable distance away. In addition the spindle head is equipped with a quill which produces endwise feed at any angle.

In the set-up down here an end mill is being fed endwise at an angle of approximately 45 deg. while working on a holding fixture. A variety of auxiliary fittings for this machine cover a wide range of work, including slotting, grinding, sawing, drilling, etc., at any desired angle.

15—Three Parallel Surfaces Milled in One Setting

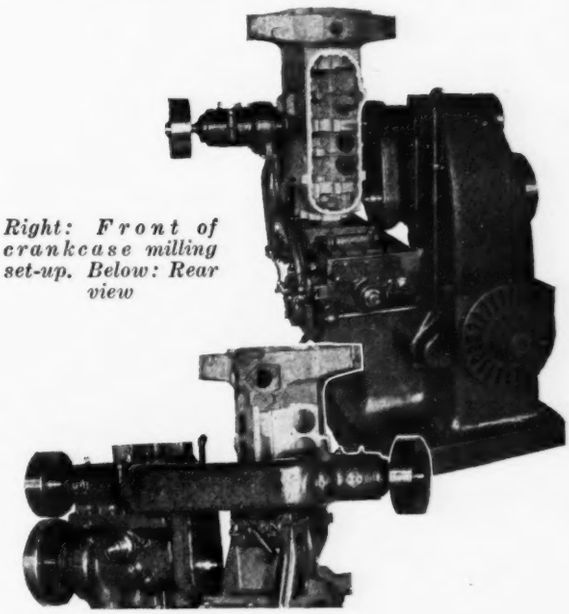
THREE parallel surfaces, one of which is on the opposite side of the eight-cylinder, vee type aluminum crankcase, are milled in one setting on a standard Sundstrand Rockford Rigidmill equipped with a special head assembly. This ingenious combination replaces three machines with three different tool set-ups and all of the incidental handling. Here again the combination of the tooling and the set stops which control the action of the table produce what is practically a special cyclic machine in which the operator loads the machine and depresses a start lever. The work is advanced to the cutters rapidly, then slows down to the best cutting rate and at the completion of the operation returns to the loading position and stops for a repetition of the cycle.

As shown by the illustrations, the crankcase casting which already has passed through the primary milling operations, rests on its chain case end in a large angle plate fixture which is fitted with a quick acting, swinging handwheel clamp. Piloted dowels in the base locate the position of the crankcase.

A standard cutter is driven by the main spindle for the machining of the lowest surface on the side of the crankcase nearest the column of the machine. A gear case, which is part of the special head assembly, encloses a train of gears which drives the second higher spindle and cutter for the same side of the crankcase. The bearing assembly for the second cutter is bolted to the top of the main spindle head while the entire special head is mounted in the regular overarm pocket. At the upper point of the special head a special hollow rectangular overarm or yoke extends around the casting and is supported at the outer end by a heavy cast brace.

At the outer end, this rectangular overarm terminates in another spindle head which mounts the cutter for the surface on the outer side of the crankcase. Drive for this spindle is enclosed in the hollow overarm or yoke. An adjustable main spindle which is a feature of the standard machine, and quill arrangements for the special heads allow full compensation for cutter variation.

An interesting feature is the mounting of flywheels on all of the spindles. As the casting to be milled is aluminum, the cutters are rotated at very high speed and the flywheel action is conducive to smoother finish.

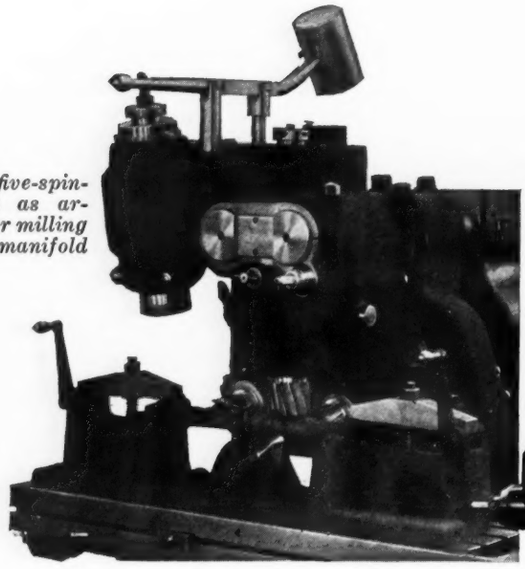


Right: Front of crankcase milling set-up. Below: Rear view

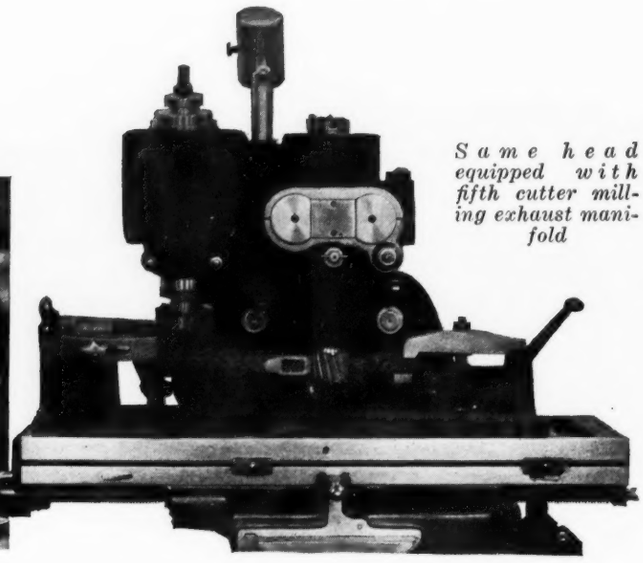
16—Manifolds Completely Milled in One Pass

DUE to the flexible characteristics of a special five-spindle head which is attached to a Kearney and Trecker Milwaukee No. 2-A manufacturing milling machine, either exhaust or intake manifolds of one of the large production manufacturers is milled completely in one pass through the machine. This work is done, not as a makeshift, but due to careful design which makes the head fully adaptable to either job. Production rate for the exhaust manifolds is at the rate of 50 pieces per hr., while the hourly rate for intake manifolds is 20 per cent greater.

Different fixtures are used for the two jobs as each is designed to hold the respective piece to the best advantage with particular stress placed upon clamping the work firmly at points nearest to the surfaces to be milled. In conjunction with the clamps, which are actuated in all cases by hand



Special five-spindle head as arranged for milling intake manifold



Same head equipped with fifth cutter milling exhaust manifold

levers and cams, the work supports are located so that deflection and chattering are eliminated. Details of the two fixtures are explained to the best advantage by reference to the illustrations.

In the five-spindle head, as shown, three horizontal cutters are used. Endwise adjustment is provided for the two outside cutters while the position of the center cutter is fixed. The vertical cutter spindle can be moved with the overarms for adjustment in and out and is carried in a quill which is counterbalanced by the weight and linkage shown at the top of the machine. In the working position this quill is located by the plunger shown at the center of the vertical head. Withdrawal of this plunger allows the cutter to move up into the vertical head during the loading period and thus speeds and simplifies the loading operation.

The diagonal spindle for the exhaust pipe flange which is idle while the intake manifold casting is milled is adjustable radially and incorporates an adjustable quill to insure the proper relation of this milled surface to all others.

All surfaces are swept by longitudinal movement of the table bearing the fixtures. For all of the port faces, three 2 in. x 3 in. high speed shell end mills are used for either manifold. The hot spot joint surfaces are milled by 3 in. x 3 in. high speed shell and mill which is used as an end mill for the intake manifold and a slab mill for the exhaust manifold. In the exhaust manifold set-up, a 4½ in. diameter inserted tooth end mill is used for the exhaust pipe flange. The rate of table feed is 7 in. per min. Speeds of rotation for the various cutters are: 4½ in. dia.—96 r.p.m.; 3 in. dia.—130 r.p.m., and 2 in. dia.—160 r.p.m. Rapid traverse brings the fixture back to the loading position and stops the machine at the conclusion of each operation.

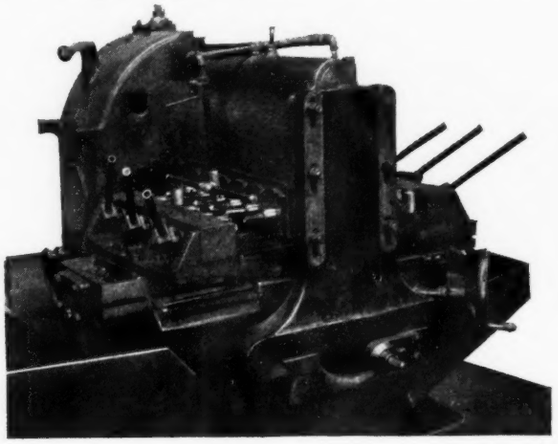
17—High Production With Special 12 Cutter Head

UNIVERSAL joint ends of Bendix front brake cams are milled at the rate of 180 pieces per hr. in a Kempsmith No. 33 Production miller equipped with a special 12 cutter head and two opposed fixtures each with six work holding jaws.

As shown by the illustration, forged pieces are loaded into one fixture while the other is in operation. The rough turned barrels are centered in vee blocks and secured two at a time by an equalizing bar and eccentric clamp. Proper angular location of the cam is assured by a spring loaded locating slide.

The cutter head is carried by the overarm and given additional support by a special bracket at the outer end of the bed. Two-lipped spiral end mills of 15/16 in. diameter are used and the cutting speed is 78 ft.p.m. Stops are arranged to stop the table at the conclusion of the operation. The table is then shifted so that the opposite end is brought into operation while the operator reloads the first fixture. With the exception of the special spindle head and fixtures, the machine is completely standard.

A PAMPHLET on Grinding Wheels has been issued by the Bureau of Standards, Washington, D. C. It contains a simplified list of sizes and shapes of grinding wheels adopted at a joint conference of manufacturers, distributors and users of grinding wheels.



Forged pieces are loaded into one fixture while the other is in operation

Fitting Material-Handling Equipment *to the* Job

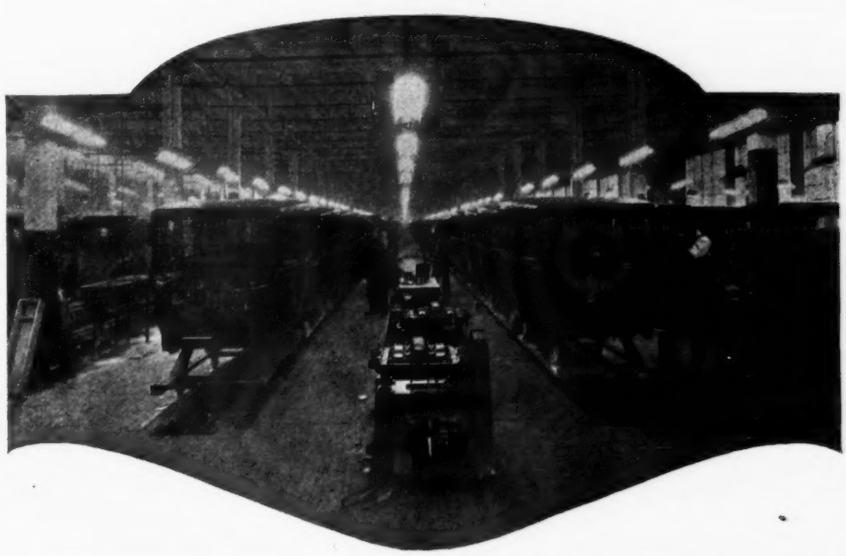
Many factors must be taken into consideration in selecting equipment which is best adapted for a particular type of work. No hard and fast rules apply.

By K. W. Stillman

DESPITE the fact that practically every automotive plant today is using mechanical handling equipment to a considerable extent, there are probably few plants in which this aid to greater profits is being utilized to the fullest measure of its possibilities.

To the public, reference to the manufacture of automobiles immediately brings visions of a slow moving conveyor progressing down through the shop; starting empty in the far distance; then receiving loads of frames, engines, wheels, bodies, etc., with scores of men working frantically to tighten up a nut, drill a hole, fasten a screw or do a half hundred other jobs before the conveyor moves their work past them, past all the other workmen and on to the floor as a completed car.

This particular feature of material handling, however, while possibly the most spectacular of any to be found in an automotive plant and of very great importance in the production scheme, solves but one—and possibly the easiest—of a hundred or more material-handling problems which confront every plant manager.



Chain conveyors of various types are quite generally used on final assembly lines

It has been estimated that of the entire cost of an automobile about 90 per cent represents material-handling costs. A considerable part of these handling charges occur in the cost of raw material used in production but there is still left a large enough proportion of handling costs within the automotive plant to warrant the immense amount of time, effort and money which have been and are being expended in finding ways to facilitate material movements.

When mechanical handling was first introduced to industry the principle claim made for it was that it would reduce indirect labor charges. Since it was frequently found necessary to employ more man hours to move materials about a factory than for fabrication of the raw materials into the finished product, this claim seemed ample—and, in general, was found to be so in practice—to convince industrialists of the economies of certain types of mechanical handling equipment over man power.

Later investigations have shown, however, that the decrease in indirect labor costs may and usually does represent but a small fraction of the total savings made possible by mechanical equipment. These other savings, as suggested by the Society for Electrical Development, are 10 in number and consist of the following:

1. Pace setting. Assembly conveyors offer the best example of how mechanical equipment assists in obtaining the flow of work best suited to the conditions, but other forms of equipment tend to produce the same results although, possibly, to a lesser degree.

2. Decreased inventories. The faster production rate which is an almost invariable accompaniament of the supercession of hand equipment by mechanical decreases the time that work is in process.

3. Decreased labor turnover. Mechanical equipment elimi-

nates the disagreeable features of many heavy handling jobs and when properly designed, has enough overload capacity to care for the occasional peaks in production.

4. Decreased hazards. Before the advent of mechanical equipment a very large proportion of industrial accidents occurred in the handling of materials. Properly designed and controlled mechanical equipment cuts down these hazards.

5. Increased effectiveness of manufacturing and storage areas. Congestion is eliminated, work in process is kept moving from station to station, greater loads can be stored in a given space and workmen are less impeded in their productive efforts when mechanical equipment is used.

6. Decreased spoilage. Use of properly designed power equipment prevents much jarring, dropping, and general rough handling which often results in a considerable spoilage loss.

7. Increased effectiveness of skilled workers. The greater dependability of mechanical equipment and its overload capacity assures each skilled worker that necessary material will be ready for him when needed and that finished parts will be taken out of his way. Thus delays for material may be practically eliminated and the workmen are not hindered by excess material piled around their machines.

8. Simplification of inventory records. The practice of holding all material in unit loads facilitates keeping of records.

9. Decreased management. Amount of management needed over unskilled workmen varies directly with the number of workmen. Reducing their number by the use of mechanical handling equipment, thus decreases management cost. In addition, because of its pace setting features, mechanical equipment lightens the management loads over productive labor.

10. Improved morale. Elimination of hand labor of arduous kinds, with the substitution of more intelligent, better paid workmen which mechanical equipment makes possible, has a beneficial effect upon the morale of the workmen and increases their efficiency.

Although it is obvious that in every material handling installation some, if not all, of these factors will be influential in determining the net results of the change there has been no way developed yet by which their influence may be analyzed quantitatively. After determining the comparative costs and savings of any contemplated change of equipment in terms of factors which are evaluated in the usual accounting system, the importance of these other factors can only be estimated. But that they should be considered—and very carefully—is an essential requirement to the proper selection of the best type of equipment to be used.

The Engineer's Greatest Problem

This problem—the selection of the best type, and size, of equipment to be used for any particular job—is the most important one which now confronts production engineers. It is usually fairly easy to decide that power-equipment may be more economical to use than man power. But with the almost infinite variety of types and sizes of handling equipment available it becomes a real problem to determine which one of them will best meet the requirements of the job.

As far as the prime cost considerations are concerned, there has been developed a method which suggests how the best equipment may be determined mathematically from ordinary accounting data. This method has been developed by the materials handling division, the American Society of Mechanical Engineers, and includes five formulas designed to give all the facts usually required in deciding upon the economies to be obtained by supplementing one type of mechanical handling equipment by another.

It is hardly to be expected that these formulas will give directly comparable results in two or more plants because of the variations in the values given to the several factors. But they should prove useful to an individual plant. The formulas are as follows:

Long conveyor lines are used for bringing material to machines and removing finished work

Electric trucks find uses in every plant. This machine floor is also served by a narrow gage railway

Let:

Debit Factors:

A = percentage allowance on investment

B = percentage allowance to provide for insurance, taxes, etc.

C = percentage allowance to provide for upkeep

D = percentage allowance to provide for depreciation and obsolescence

E = yearly cost of power, supplies, and other items which are consumed, total in dollars

Credit Factors:

S = yearly saving in direct cost of labor, in dollars

T_a = yearly saving in labor burden, in dollars

T_b = yearly fixed charges, in dollars, on mechanical equipment employed as a standard of comparison or which will be displaced

U = yearly saving or earning through increased production in dollars

X = percentage of year during which equipment will be operated

I = initial cost of mechanical equipment

K = unamortized value of equipment displaced, less its resale or scrap value

Results:

Z = maximum investment, in dollars, which will earn simple interest

Y = yearly cost to maintain mechanical equipment ready for operation (fixed charges)

V = yearly profit, in excess of simple interest, from operation of mechanical equipment

P = yearly profit from operation, in per cent on investment

H = years required for complete amortization of investment out of earnings.

Then

$$Z = \left[\frac{(S+T_a+U-E)X+T_b}{A+B+C+D}\right]-K \quad . \quad [1]$$

$$Y = I(A+B+C+D) \quad . \quad . \quad . \quad . \quad [2]$$

$$V = [(S+T_a+U-E)X+T_b]-[Y+(KA)] \quad [3]$$

$$P = \frac{V}{I}+A \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [4]$$

$$H = \frac{100 \text{ per cent}}{P+D} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [5]$$

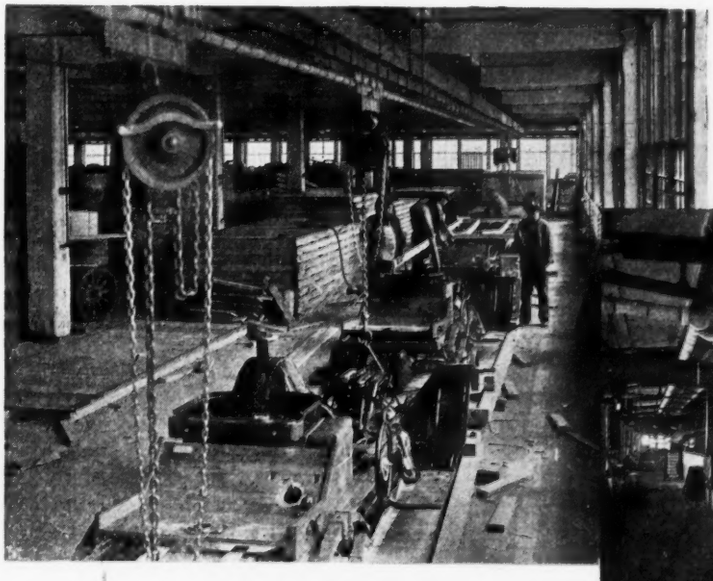
By means of these formulas the man who is considering the purchase of new mechanical equipment can determine the four facts which interest him most: Cost, amortization, percentage return on investment and increased production.

Although they were designed to compare the economies and efficiency of a contemplated piece of equipment with one in use or with an operation performed without machines, it is quite possible to use them in obtaining comparative data between two or more types of equipment being considered.

As suggested before, results obtained by the use of these formulas can not be considered final until they have been considered carefully in the light of the ten factors mentioned above. Even though a particular type of handling equipment might prove much more economical from a strict accounting standpoint, as shown by the A.S.M.E. formulas, it might rate so poorly in regard to pace setting, elimination of idle time, or some other factor as compared to another type of equipment that adoption of the latter might be more profitable.

Proper evaluation of these factors in any particular instance calls for a high degree of judgment inasmuch as there seems to be no method by which their value may be determined other than by estimation.

In general, certain types of equipment have been found most suitable for particular operating conditions and classes of work. Thus power conveyors are used almost



Combinations of hoists mounted on mono-rail track effectively solve many handling problems

Short conveyors are for loading and unloading ovens in connection with overhead cranes for bringing and removing parts

universally in the final assembly lines of those plants whose production warrants the use of power equipment. The shape and size of the load to be carried, the amount and kind of work to be done upon parts being conveyed, the necessity for constant and uniform progress, and other similar considerations have practically eliminated other forms of power equipment from this particular service.

In no other service, however, is there such uniformity in regard to the material handling equipment used in various automotive plants. It may appear strange that in plants where practically identical products are made similar materal handling methods are not used. The utter lack of standardization of such equipment among automotive plants serves to emphasize the importance which the industry has given to the fact—so often lost sight of—that for every material handling job there usually is one type and size of equipment — and only one — which will best meet the particular operating requirements of that job.

In other words, the same sort of analysis is made of a material handling job as is made in modern organizations in placing workers. Never are the conditions under which material is to be moved identical with those of another moving job. The size, shape and weight of the items to be moved, the distance to be covered, the rate of speed necessary, the volume of flow, whether the movement is vertical, horizontal or a combination, and other similar factors all influence the selection of equipment. And for any particular combination of these factors there is usually but one type and size of equipment which will serve the purpose most satisfactorily. The problem which confronts the management is to select this type.

This view indicates the immense variety of devices which may be used for handling material in a modern plant

Unfortunately, there are so many factors to be considered and their variations in particular instances may be so great that it is quite impossible to set forth any definite rule or formulas for assuring a proper selection. General limitations and adaptations of main types of equipment may be given but the final judgment must be made by someone familiar with the particular work to be performed.

In general, there are three prime requisites in addition to economy which every successful material handling installation must possess. These are, adequacy, dependability and flexibility.

The equipment must be capable of handling all the material necessary to keep the production processes going at full speed with enough over-load capacity to take care of unusual conditions and it must be able to continue doing this work day after day with no—or an absolute minimum of—failures. The importance of this point is not always realized but when one considers the importance given in a modern factory to a stoppage of a single production machine, of how much more importance is a breakdown of handling equipment which may effect the output of a dozen machines.

Flexibility of equipment is necessary because of the constant progress which is being made in designs and in production methods. True that every mechanical handling installation should be made to satisfy very particular requirements existing at the time of its installation; but the fact also should be considered that next month or next year improvements in designs or methods may be made which will eliminate or greatly depreciate the value of the installation.

Installation of an expensive system which cannot readily be adapted for changed conditions will exercise an undesirable influence against improvements, or, if they are made, will make them much more expensive than they might be otherwise. With portable equipment the ultimate in flexibility is obtained. With other types comparative flexibility can only be obtained by very careful consideration of its present uses and reasonable anticipation of future progress.

These three requisites of adequacy, dependability and flexibility are, of course, very general in character and their consideration will prove to be of little practical value in the final determination of the equipment to be used.

In this final decision there must be included a thorough knowledge not only of the characteristics of the various types of equipment but, more particularly, of the conditions under which the equipment finally selected must operate.

Factors to be Considered

Obvious factors which must be considered include the material to be transported—its unit weight, volume, shape and size; the rate of flow needed to meet production requirements; the distance of the movement; the amount and kind of work which may have to be performed upon the material while in motion; and whether the movement is horizontal, vertical or a combination of the two.

Other factors, not so obvious, but which may often be of as much, if not more, importance than those already cited, include items which affect the 10 by-product savings from the use of mechanical equipment as suggested early in this article.

In conclusion, it may bear repeating that a proper selection of mechanical handling equipment can be made only by someone intimately familiar with all the conditions affecting the operation. There can scarcely be too much information available to the one responsible for the selection, and the task of analyzing the situation and finally synthesizing the elements into a proper decision deserves of the best engineering and production talent available in an organization.

Just Among Ourselves

Conventions—What Makes Them Good or Bad?

HAVING returned recently from the opening week of convention attending for the fall season, we find ourselves reflecting again on a question that often has puzzled us in the past—"What is it that makes people go away from a convention saying 'That was a fine meeting' or 'That was a bust,' as the case may be? What is it that turns the scales for or against a meeting in the minds of the average automotive man attending it?" Right away somebody will say "Why, the quality of the papers or talks presented, of course." But we doubt it. Poor papers will make a meeting unsuccessful, to be sure, but good papers won't necessarily make it successful. We've been to plenty of meetings where the papers maintained a fairly high average quality and still most people came away feeling more or less cold to the convention. We went to one like that not long ago, so the experience is recent enough to make us fairly positive on this point.

* * *

Hard to Lay Finger on Determining Factor

"MAYBE it's the attractiveness of the plant visits or the social events held in connection with the meeting which are the determining factors," we seem to hear somebody else suggesting. That these have an important bearing on the matter, just as has the quality of the papers, cannot be denied, but again some darned good parties have been staged in connection with conventions without sending the boys away enthusiastic. The efficiency with which the meetings are run also has a major effect on determining convention success, as does the ability of the speakers to hold the interest of their audiences by the manner in which they make their presentations. Then too the activity and sincerity of the local committees in charge of national meetings has much to do with the results. But behind all these factors is something else; something we haven't been able to lay our hands on, but of whose presence we feel certain after a good many years of fairly constant convention attending.

* * *

Maybe It's "a Little Bit of Barnum"

WITHOUT being able to define this something accurately even in our own mind, we have the feeling that it might be called "a little bit of Barnum." A little bit of Barnum applied to the selection of topics, to the presentation of the papers, to the staging of the meeting, to the putting over of the social events, to the advance promotion of the meeting, and to the hundred and one other factors which go to make up a technical, sales or general convention of any kind time, time again has raised it from mediocrity of real success. Sound papers, good entertainment, careful mechanical preparations for running off the sessions without a hitch—all these things are essential. Without them all the Barnum in the world won't put over a successful modern business meeting. But even with the sound fundamentals present, that little bit of Barnum is needed. Look back over the conventions you've gone to in the last year or so, pick out those which to you have seemed particularly good and see if they all didn't have some Barnum in them. Then we'd be glad to have you write us and tell us what you think.

Color Service, Not Just Paint, is Demanded

WE'VE talked a bit lately about the growing importance of artistic color work on automobiles. Heard a story the other day tending to bear out this idea. A lacquer salesman went to a car factory executive and started in to give his regular solicitation. The executive tried to interrupt him once or twice, but the salesman kept on to the end. Then the executive said: "That's a good story. I believe it. I believe that your product is good and is entirely capable of filling our needs. I believe also that the same thing is true of the product of three or four other lacquer makers. I have four new models coming out. The thing that is bothering me is the question of proper and attractive color combinations; I want something artistically correct and something with sales appeal. The paint company that gives me the best service in this regard is going to get the order; I'm satisfied with the quality of the product of several companies." More attention is being given to the artistic side of color combinations than ever before.

* * *

Traffic Violations and Enforcement

LAST year 27,000 automobile drivers were arrested in Philadelphia for violation of traffic rules; 20,000 were discharged by the magistrates. Detroit has in operation a "Violation Bureau" which imposes fines. Ninety per cent of those fined accept the decision; only 10 per cent insist on trial before the special traffic court. Sure, rapid enforcement of existing regulations is perhaps the most important element in solving the traffic problem of many cities today.—N. G. S.

S. A. E. Production Meeting

Metallurgy of Growing Importance to Automotive Men

One of chief subjects discussed at S. A. E. production meeting. Papers touching on many new phases of manufacturing hold interest at sessions

THE growing importance of metallurgical study in automotive production was emphasized last week by the amount of attention given to this phase of the manufacturing problem at the annual production meeting of the Society of Automotive Engineers held at the Hotel Sherman, Chicago, Sept. 21-23. Outlining the effects of various crystal sizes on gear production and performance brought about a widespread exchange of experiences on the opening day of the meeting; new methods of inspecting metal surfaces by use of a photoelectric cell were described on the second day; and the big steel and machine tool exposition of the American Society for Steel Treating, held in Chicago simultaneously with the S.A.E. meeting, received most careful inspection from nearly all of the two or three hundred production men registered at the automotive session.

O. W. Young, as chairman of the Factory Inspection Committee, had charge of the visits to the Nash, Yellow Truck and International Harvester plants

Every year it becomes more evident that automotive production progress, while still going forward at a steady rate, is ever being concentrated more strongly on the improvement of a mass of detailed methods and operations rather than in major renovations of current practice. This trend, in addition to the metallurgical interest mentioned, was perhaps the chief feature to be noted at this particular S.A.E. meeting.

In the conveyor session, for example, Paul Phelps and N. H. Preble devoted their paper to discussing specific examples of how conveyors of various types can be adapted to other than assembly operations, while Clarence A. Brock talked in some detail of the various types of chains and drives employed on conveyor equipment. The inspection session saw men from Chandler, Oakland, Continental Motors, Packard, Yellow Sleeve Valve Engine Co. and AC Spark Plug Co. describing a multitude of small, though important improvements which are being incorporated into current inspection work, while much of the same attention to detailed, practical problems characterized the discussions at the machine tool and gear sessions which completed the program.

Taliaferro Milton, chairman of the Reception Committee at the 1926 Production Meeting

Surveying the entire range of information presented, it becomes apparent that the course of present automotive production development, while different in character from that of five or ten years ago, is resulting in efficiencies and improvements of no less moment and of no less significance from the standpoint of lower price and higher quality.

Discussion at the various sessions this year indicated

a practical interest in the problems brought up on the part of those in attendance, but the number participating in any individual session was on the whole somewhat smaller than at most previous production meetings.

The plant visits, on the other hand, seemed to be patronized relatively somewhat better than usual, Nash Motors Co. at Kenosha, Yellow Truck & Coach Manufacturing Co. and the International Harvester Co. all being hosts to somewhere between fifty and one hundred S. A. E. conventionites.

The social events of the meeting included a stag smoker at the Chez Pierre on Tuesday evening and participation in the smoker and frolic of the American Society for Steel Treating on Wednesday evening.

Steel Strength and Hardening Methods Discussed at Gear Session

Better means of checking fatigue and resistance to impact sought. Many difficulties in gear production.

FORMULA and ultimate tensile strength of steels have ceased to be sources of worry to the metallurgist and gear manufacturer. These two items are established quantities which are taken as a matter of course by both steel maker and user. But men responsible for the manufacture and heat treatment of steel parts are most concerned over the properties of fatigue and resistance to impact. As yet no conclusive means for the checking of these properties has been developed, although the need is urgent. These statements, made by Walter G. Hildorf, metallurgist, of the Reo Motor Co., in conjunction with his portrayal of the effect of crystal sizes in his paper, "Gear Steels and the Production of Automobile Gears," were perhaps the outstanding features of the gear production session.

Lively gear sessions along either engineering or production lines are becoming almost a tradition and this meeting lived up to antecedents in every respect. Outstanding points of difference of opinion were the relative noise characteristics of oil hardened and cyanide hardened gears. One group adhered to the idea that gears hardened by the latter process are the noisier. Another group was equally emphatic in the opposite opinion. Still a third group asserted that the method of hardening was not the determining factor but that the finish of the green gear accounted for noise or silence. While the consensus of opinion drifted apparently to the third view, no conclusion was reached.

Another bone of contention was the effect of the size of Fellows gear shaper cutter on the rate of production. This controversy was launched by Eugene Bouton, of the Chandler Motor Car Co., who asserted that the use of a cutter of 4 in. diameter in place of the usual cutter of smaller diameter will increase production by at least 20 per cent due to the use of a larger pitch gear which speeds up rotation of both the cutter head and the work. He asserted that no troubles with the machine followed because only these rotary motions are increased while the reciprocating motion of the cutter head continues as with the smaller cutter. Here again no satisfactory conclusion was reached in the meeting, although a tendency toward Mr. Bouton's opinion was shown.

Another phase of cyanide hardening was brought out during the discussion when the idea of heating the blank in a furnace and then transferring it to a cyanide bath of the same temperature was advanced. Following cooling after this process, the gear is held in boiling water for two hours. It is stated that this method eliminates the bulk of the trouble following the usual cyanide hardening process.

The second paper of the session, "Automobile Gear Production," was presented by F. G. Eberhardt, of Gould and Eberhardt, in the absence of the author, Charles L. Cameron, of the same company. In this paper, gear cutting as related to production on the hobbing machine was discussed. Also the salient details of the latest type manufacturing hobbing machine. An interesting angle was the statement that one of the prime factors contributing to the present high rate of production is the use of hobs of 4 in. diameter instead of the former smaller diameters.

The session was in charge of Robert S. Drummond and the attendance was about 100. Mr. Hildorf, whose paper was prepared in collaboration with John Bethune, also of the Reo Motor Car Co., spoke in part as follows:

The production of satisfactory gears is one of the most serious problems confronting the automobile manufacturer today. The choice of gear steel and its heat treatment is closely allied to this production problem.

Walter G. Hildorf, Reo Motor Co., presented a paper at the gear session on the production of automobile gears

Ring gears are finished by the spread blade method which we believe is the usual practice in most factories. The pinion is not finished in the usual way, but after teeth are roughed, in a fixture mounted on a small milling machine and cutting a 3/16 in. keyway in the stem. This fixture has a plunger which enters a tooth space, so that

the keyway is always cut in a definite relation to the teeth.

After the gear teeth are roughed, they are chamfered on the large end, or outside of the gear. A vertical hobbing machine with a special hob is used for this purpose. We consider it better to do the chamfering before the teeth are finished because it might raise a burr on the tooth profile.

Before hardening the pinions are burnished in a Gleason burnishing machine without any oscillating movement of the pinion. A light tension is used and the gear is raised and lowered continuously during the burnishing operation so that all parts of the tooth come into contact.

The gears are put into pairs on a testing machine and then lapped on a lapping machine.

The pinion should be straddle mounted.

The gears should be cut with a 9 in. cutter because the path of the blades then more nearly intersect the apex of the gear and give less of the screw gear effect than with a 12 in. cutter.

John Bethune, co-author of the gear paper read by Mr. Hildorf at the gear session

If hyphoid gears are used the overhang of the pinion from its bearing is more than with the regular spiral bevel gears and the straddle mounting becomes still more desirable.

Considerable experimenting has been done with the passenger car gears in an attempt to get a greater degree of quietness. Various experimental sets of gears were made using the same pitch and number of teeth. These sets included, different pressure angles, various addendums and dedendums and various center distances. A large number of experiments were also carried out using ground gears. In no case was the degree of quietness, under load, any better than with the standard 20 deg. full depth teeth. A decided decrease in sound was obtained by the use of finer pitch gears.

The selection of a proper gear steel is quite difficult because there are so many variable factors, such as loads, ratios, pitch, long or stub teeth and whether the gears are to be used in a passenger car, truck or bus. The three following oil hardening steels are quite generally used:

S.A.E. 3250, S.A.E. 5150 and S.A.E. 6150

Of the carburizing steels, S.A.E. 2315 and S.A.E. 2512 are often used, the former being quite a favorite for use in ring gears and pinions.

When gears are heated for forging they should be heated slow enough so that they will be heated uniformly throughout the cross section. Optical pyrometers are very useful in determining forging temperatures. Wherever possible we upset our gear forgings in order to obtain uniform strength in the teeth and eliminate warpage.

Machining results are often variable even through the Brinell hardnesses and structures are identical. We believe it is safe to say that the eyanide treated gears will wear much better, will be somewhat noisier and have a different sound than the electric furnace treated gears.

The quenching medium and methods of quenching are also important. The normality of steel also has its effect upon warpage.

The fracture test consists of taking samples from the rolled bars about 9 in. long and if the steel is S.A.E. 3140, heating it to 1550 deg. Fahr., holding at heat 1½ hr. and cooling in the air. Then heating to 1425 deg. Fahr, and cooling in the furnace. The bars are notched by sawing about 1/3 off at the center. They are broken by supporting the bars at each end with the notch or saw slot downward and slowly applying a load at the center. The desired fracture is silky fibrous.

A bar with a crystalline fracture is very brittle. In most cases, the regular heat treatments will not change this material so that it will break tough. When using such material the fracture of the finished product, after being hardened and drawn in most cases cannot be distinguished from that of the original bar.

To determine the amount of inclusions in steel we fracture hardened disks. The disks are supported around the outside, a ball is placed at the center and load applied until the disk breaks. This is much more satisfactory in most cases than an examination under the microscope.

The grain size varies enormously from heat to heat of steel, and to a lesser degree in the same heat. It does not seem possible by ordinary heat treatment to bring grains of different samples to the same size and keep them the same. Some are naturally large and grow readily while others seem to be naturally small and remain small.

From what has been done this far it seems that large grained steel is always more brittle than fine grained steel, that the smaller grained steel has a wider hardening range and if we are to have a steel with a naturally small grain it must be made such at the steel mill.

Cameron's Paper

Mr. Cameron's paper read in part as follows:

Although the method used in the production of gearing in the many automobile plants vary considerably, each is endeavoring to produce quiet gears at the lowest possible cost.

Not very long ago a prominent automotive engineer claimed that most of the gear troubles could be attributed to the hobbing machines and he advanced the idea of a machine of extreme simplicity and this started a development in spur gear hobbing machines that has revolutionized production by the hobbing process.

The first construction of the simplified hobbers was built around the idea of having a machine that only had four gears in it, two to drive the cutter and two to drive the work, but this principle involved so many limitations that out of it has developed a machine that may be referred to as a flexible specialized function machine, not limited to any one gear, but for a number of different gears.

The simplicity of the hob generating method and continuity of action for cutting gears, when compared with other processes, has always appeared mechanically right.

In cutting transmission gears on a hob generating type machine the roughing operation is usually done with multiple thread hobs, while the finishing of the gear teeth is done with single thread ground hobs.

The cutting of helical timing gears has presented more problems in the automobile industry than any other branch of gear cutting, because of the exacting requirements necessary to produce quiet gears.

A gear is a product of the gear cutting machine, the cutting tool and the operator; consequently the gear produced can be no more accurate than the combined accuracy of all these factors. If this statement is kept in mind, as well as exercising care in mounting timing gears, it

will go quite a long way toward eliminating gear troubles.

Automobile flywheels and starter ring gears are cut by almost all manufacturers by the hob generating method as advantage can be taken of using multiple thread hobs.

Owing to the high numbers of teeth that flywheels usually have, it is also important to use full length hobs, as the generating area is much larger than that on smaller gears, such as transmission gears.

Steering worms are cut by some companies with thread milling machines and gear shapers, while others are using the hob generating method, which is a comparatively new process, offering many advantages.

In using the hob generating method a special worm generating hob has been developed, which permits hobbing single and multiple thread worms. This special hob with the continuous indexing of the hob generating machine is capable of producing extremely accurate worms, both of lead and spacing of threads. The cost per worm with this method is also cheaper.

The hob used is quite different from the conventional hob in that it has only two convolutions of teeth in which there are only three teeth that do the final finishing of the threads, the other teeth doing all the roughing.

The cutting of automobile steering worm wheels is best adaptable to the hob generating method, being cut by the infeeding method of feeding the work into the hob or vice versa.

In using single thread hobs the hob is made of a large diameter than the worm and is swiveled or set off at an angle to suit the helix angle of the gear teeth to be generated. With this practice a spot or center bearing is produced on the gear teeth, which has worked out satisfactorily for a steering apparatus.

Most automobile steering worm wheels mesh with double thread worms in which cases quadruple thread hobs are sometimes used. In cases of this character the hobs are made to such diameters that the helix angle of the hob corresponds with that of the wheel and the hob is set at right angles to the axis of the worm wheel. With this method the throat radius is enlarged and the bearing is almost full or equivalent to that production in using a hob similar to the worm that meshes with the wheel.

The hob generating method is used more extensively on the cutting of spline shafts preparatory to heat treating and finishing by grinding. This is due to many concerns desiring to heat treat the shafts to such a hardness that they cannot be machined and the grinding of the side must be resorted to.

Great Possibilities Seen in New Inspection Devices

Apparatus which does away with manual inspection described. Bonus wage system for inspectors is suggested.

SUGGESTION of the possibilities of installing some sort of incentive system of wage payment for inspectors and description of a new mechanical device for substituting definite values for individual judgment in the inspection of a wide range of properties were the features of the inspection session held Wednesday morning.

A. H. Frauenthal, Chandler-Cleveland Motor Corp., questioned the practice of including inspection under the general head of indirect labor. Inspection has such a close relation to the productive output, Mr. Freuenthal believes, that it should be regarded as direct labor and the various inspection operations and methods of payment used should be based on that assumption.

Since the use of mechanical inspection devices rather than manual inspection contributes greatly to the facility with which inspection can be placed upon a production basis, the paper presented by E. D. Hill, Western Electric Co., was of particular interest in showing the extent to which mechanical devices can be adopted for inspection work.

Possibly the most interesting device of this type, and one which appears to have almost limitless possibilities, although it is still so new that few of them have been determined, is the sort of machine described in the paper by C. S. Stark, Packard Motor Car Co. This machine is used at the Packard plant to determine the character of finish which is given to metal parts requiring a very smooth surface. Its principle operating element is a photoelectric cell which has the property of responding almost instantaneously, by changing its conductivity to an electric current, to minute variations in intensity of light directed upon it. By reflecting light from the surface to be tested to the cell, amplifying the current set up through an ordinary radio amplifying tube and reading current variations on a milliammeter, the Packard Co. has been able to determine accurately how any particular surface compares with a previously determined standard.

In Mr. Hill's paper considerable attention was given to a machine of very similar type which was developed to test insulation resistances. A similar machine has also been used to test cigars by color matching—the machine being able to differentiate 27 different shades of brown. It was brought out that such a device, specially adapted for the particular conditions might be used for obtaining absolutely accurate color matches in car finishes, for standardizing the luster of such finishes, for making automatic inspections of length, pressures, temperatures and many other characteristics.

Speakers at this session, in addition to Mr. Frauenthal and Mr. Stark, were P. W. Rhame, A. C. Spark Plug Co.; J. B. Scott, Yellow Sleeve Valve Engine Co.; A. R. Fars, Continental Motors, and R. R. Tood of Oakland.

Placing Inspectors on Quality Bonus Basis

SUGGESTING that the entire inspection department might profitably be placed on a quality bonus basis, Mr. Frauenthal said in part:

From the salvage department reports of past performance, the amount of rejected and scrap material could be priced and divided by the number of cars or units produced during that period which would then establish in an approximate degree the average amount of rejected material on a car or unit basis. The number of inspectors reqired could be ascertained from employment record analysis, job analysis and car or unit production. These factors being determined, it would then be possible to establish a quality bonus incentive plan for the inspection department.

In a good many plants the number of inspectors required is determined by the number of productive workers. This method seems to disregard the amount of actual inspection required on the individual parts and, consequently, these ratios and percentages are frequently meaningless. An analysis of the time required actually to inspect the various parts which enter into any given unit would seem to give the most reasonable and practical data concerning the actual number of inspectors required for the production of any given product.

While practically all direct labor in the automotive industry has been subjected to the closest scrutiny of industrial engineers selected for the purpose, and very substantial savings have been made permitting reduction in labor costs tremendously, the so-called indirect workers have been more or less sidetracked and it is reasonable to assume that proportionately as great savings can be made in this division of manufacturing.

A stime study of our cam roller inspection brought about a considerable final saving and a description of the methods now used follows: The rollers are received covered with oil for rust prevention purposes and, as the first operation, are washed.

The rollers are then taken to the inspection bench and placed on a rod where the outside diameters can be wiped off with one or two sweeps of a rag and carefully examined for surface defects. After this they are laid in wooden V blocks which are for the purpose of keeping them in an orderly arrangement preparatory to handling in the next operation. The hourly production is 2259.

The next operation, that of checking the bore and classifying for size, is the most important and perhaps the most interesting. The operator first takes a handful of rollers in orderly arrangement from the V block and runs a swab through the entire handful. The rollers are then placed one at a time upon a special direct reading dial gage. The rollers are here classified for bore diameter and checked for roundness as well as checked for being within the specified limits of size.

This gage consists of one stationary and one moveable measuring point, both of which are approximate half circles of diameter slightly smaller than the diameter to be checked. This results in line contact when the spring arrangement forces the two points apart, holding the measuring points against the bore walls at constant pressure. The moveable measuring point is pressed into one member of a rather large frictionless bearing. The gage is set by a standard and all readings are comparative. Due to the line contact, it is only necessary to revolve the object to be measured in order to measure the amount out of round. This method is far superior to the plug gage method.

Hardness Testing

Hardness testing comes next and is done by sclerescoping at four points on the O. D. A V-block fixture with a lateral stop is used to hold and locate the roller which permits rapid loading and unloading. The sclerescope is operated by a foot pedal which leaves both hands free for manipulation. The foot pedal method was found to be 30 per cent faster than the hand bulb method.

An important item for accuracy for valve timing and quietness of operation is the concentricity of the O. D. and the squareness of the sides. Usually a 10 per cent inspection of these items is sufficient and is accomplished on special bench centers and triple indicator. The roller is placed on the mandrel, then in the centers and re-

"Inspection Along the Line" was the subject of A. H. Frauenthal's paper

P. W. Rhame spoke on "Means and Methods in Small Gear Production"

A. R. Fors, who described two new inspection devices used by his company

volved with an indicator on each side face and another on the O. D. The hourly production is 221. The last operation is thickness gaging on an amplifying gage and is usually required on only 10 per cent.

The justification for time studies perhaps requires some explanation inasmuch as no wage incentive is used. We have found at least five reasons for using them:

First—The individual inspector knows that a certain amount of work is expected of him and a man will produce more work when given a definite assignment.

Second—The foreman can check the inspector's output daily.

Third—The chief inspector can check the department's output over any given period of time with very little trouble.

Fourth—It draws the attention of every one concerned to the possibilities of economizing by better methods, mainly by impressing us with the extreme slowness of some operation.

Fifth—It is of assistance in planning the work as it is known beforehand how long it is necessary to keep an inspector on any one job to get out a given amount of work.

In this day of mechanical gaging devices there is no more reason why time allotments should not be made for some classes of inspection than for any production operation. However, a certain amount of judgment must be used to pick jobs that will respond to this treatment economically.

Allotting Time Interval

A method of allotting a fairly definite time interval for a given inspection is to adapt the inspection to a station in the production line with a definite inspection specification unbalanced in time with the production operations.

In some plants it is the practice to 100 per cent Brinell test large castings such as cylinder blocks and crankcases in the rough previous to delivery to the machine line. A few plants have adopted the method of using a small percentage hardness inspection in the rough as a pre-check and have mounted a Brinell machine in a conveyor line in such a manner that it is possible to test each cylinder as it reaches the testing machine with no extra handling. When this test is placed just beyond the milling operation, there is a saving of the grinding operation for testing as well as the expensive handlings incident to the test.

In one Detroit plant there is a continuous chain conveyor for the assembly of instrument boards, i.e., placing the instruments, wiring, etc. There are about twelve stations, the last being occupied by the inspector. This inspector has a certain number of items to inspect and the operation is well balanced with all remaining operations. It seems as if the mere fact of having this inspector on a conveyor has speeded the operation up to a point where the inspector is doing about double the work that would normally be expected if done over a bench.

In the case of our own finish machined cylinder block inspection, we are making plans to incorporate an inspection station at the end of the line with operations balanced against the machine operations. It is planned to eventually try to put the inspector in the group. This will insure his working fast enough but the big problem will be to make him careful enough.

Inspection Methods in Small Gear Production

TALKING on "Means and Methods in Small Gear Production," Mr. Rhame said:

Our floor inspection system, used in the making of the gears for speedometers, is not radically different from others. There are some points, however, that may be of interest: (1) The inspector makes the rounds of all machines, every thirty minutes or more often, and puts two or three of the last pieces made from each machine into the proper compartment in his tray. (2) He goes with these samples to his central gage bench and checks the work visually for finish and with gages for mesh and size. (3) The results of this tour are written on a special form by the inspector so that there is a complete record of the results obtained of all the machines in the compartment.

This has proved an excellent preventive method of inspecting which allows corrections to be made before many defective parts can be cut.

C. S. Stark, who told how radio amplification is used in inspection work

R. R. Todd, Oakland Motor Car Co., was inspection session speaker

Inspection of Knight engine valves was discussed by J. B. Scott

Gears and worms can be only as accurate as the hobs and cutters, machines and gages. Realizing this, we have found it necessary to resort to ground cutters and the use of a lantern projection to check them. Special machines have been designed. Even on these we have had to go to the refinement of keeping small chips from the compound and collets to maintain accurate concentricity of the parts. This is done by flowing the cutting compound through a standard AC Oil Filter which incidentally has materially reduced machine wear. The gages for this job have gone through a rapid process of evolution so as finally to meet the demands of accuracy, reliability, speed and simplicity of maintenance. Gage is checked regularly twice a week with hardened master worms and gears. This is done by men who do nothing else but check and set gages.

In all cases, inspectors have detailed written instructions of what to do and how to do it. These are read regularly, kept up-to-date, and lived up to. We feel these are an absolute necessity if uniform standards of rejection are to be maintained.

Inspection supervision should always aim to be an effective minimum and should never be content to stop developing systems and methods and equipment to obtain that end.

Inspection of Knight Engine Valves

MR. SCOTT talked on "Inspection of Knight Engine Valves." He said in part:

All sleeve castings for Knight engines are normalized to remove casting strains. The sleeves have been rough bored and turned before normalizing. It is our present practice to normalize the sleeves just as they are received from the foundry. The normalizing operation takes place in a 12-hour cycle, the temperature being gradually increased to 1060 deg. Fahr., which temperature is maintained for a three-hour period. After extensive experimentation with various means for measuring hardness, the Rockwell instrument has been adopted. By this method we obtain uniform results and are able to handle our testing quite rapidly. The hardness tolerance is 90 to 95 Rockwell.

Examination of the detailed drawing of the sleeve discloses several close tolerances and the fact that a considerable number of machining operations are involved in finishing the sleeves. Inside and outside diameter are held within .0005 in. Sleeves are permitted to taper within the diameter tolerance only. The maximum out-of-round tolerance is .004 in. at the upper end of the sleeves and .002 in. at the lower end. The distance from the center of the sleeve pin hole to the lower edges of the ports is held within .004 in. The width of the ports is held within .002 in.

The finish boring operation is performed after the sleeve has been rough bored, rough turned, centered and finish turned. In order to establish close contact between the sleeves and the water-cooled walls of the chuck, the finish turning operation is held within a tolerance of .001 in. By water-cooling the sleeve while it is undergoing the finish boring operation, the temperature rise resulting from the heat of the cut is kept low enough to prevent any considerable taper in the bore of the sleeve when it cools after this operation. Care exercised in this operation reduces the total amount of metal which must be removed from the sleeve bore in the grinding operations to a minimum.

Immediately following this porting operation, the sleeves are given a complete inspection for the relation of port edges to sleeve pin holes, width of ports, diameters, oil hole drilling and oil grooving, and the grinding relief. Extensive use is made of indicators in connection with reference gages to whch the indicators are set. This method of measurement has been found most satisfactory, because the indicators cannot be forced, accurate measurements can be made by unskilled people, accuracy of measurement is not affected by rapid gage wear, and the cost of maintaining gage is quite low. By means of Johnanssen gages the reference rings, blocks and height blocks, to which the indicators are adjusted, are inspected once a week. Temperature variations must, of course, be reduced to a minimum in all of these gaging and checking operations.

Further use of this general method of measurement is illustrated in connection with an internal grinding operation. Incidentally, and because of the very general interest which has been shown in methods of finishing cylinder bores, it may be here stated that it is our practice to grind all sleeve bores. The bore of the inner sleeve, when in a Knight engine corresponds to the cylinder bore in the poppet valve engine, is honed after grinding. Honing is regarded simply as a surfacing operation, and the honing is only required to remove from .0002 to .0004 in. of material.

After the completion of machine operations, initial and intermediate inspection operations, the finished sleeves are subjected to a close final inspection. An inspector checks the pin hole in relation to the center line of the sleeve bore. He also checks the thickness of the lugs and the depth of mill out at the lugs. Another inspector inspects sleeves for depth of the grinding relief. He also inspects the sleeve carefully to see that all operations have been completed; that the quality of the finish is satisfactory, and that no casting defects have been overlooked in previous inspection operations.

Radio Amplification in Inspection Work

MR. STARK'S paper was entitled "Making Use of Elementary Principles of Radio Amplification for Inspection Purposes." In part it was as follows:

We already have many mechanical means of inspection,—plug gages, snap gages and many other instruments for measuring to the most minute dimension. Our micrometers and snap gages measure to within five ten-thousandths of an inch with certainty. We then have for greater accuracy our amplifying gages that reduce this error to one ten-thousandths of an inch with accuracy. We also have our microscopic instruments that split a hair line and measure to 1/50,000 with accuracy. We still have our light ray means, whereby accuracy can consistently be maintained to within almost one-millionth of an inch. It does not require a very skilled inspector to operate this mechanical instrument and still insure a positive degree of accuracy unobtainable by any other method. We have means for determining very slight cracks in ground surfaces, cracks that cannot be seen even with a microscope. This is done by magnetizing the parts in question, immersing them in a solution of kerosene oil having suspended in it very fine iron dust. By this very simple magnetic action, a magnetic field immediately surrounds the crack, the fine iron particle adhere in a peculiar shape on the hardened surface which has a surface crack.

It is a recognized fact that reflection intensity is proportional to the degree of the surface finish. This led us to believe that a selenium cell would be advantageous, but we had no definite means of recording this as accurately as we desired. We then began to search for something other than the selenium cell and, in time, found that it was possible to purchase a photo electric cell, which responds practically instantaneously to minute variations in light intensity. We found that when this cell is connected in a suitable amplifying circuit to a milliammeter, the ratio of the values read on the output milliammeter gives very accurately the degree of the polish on the surface of the sample that is being tested, when the sample is exposed to a source of light and the light reflected against this cell. Of course, this becomes primarily a method of comparison and a standard must be adopted first of all, at which the value is to be established, and then the parts to be compared are read mechanically from the deflection in the milliammeter, either above or below the standard that is decided upon.

The results that we obtained after having made up one of those instruments encouraged us very much. It has been very successful in actual operation. We have continued our experiments during the past months and we are convinced that this type of instrument, though still in its infancy, will become very useful and that the possibility of it being used for many other purposes is limited only as experimentation is continued.

This instrument is not at all expensive. In fact, its cost is from $100 to $150, and the results obtained from it have been well worth the expenditure. We have never heard of experiments having been conducted by any other industrial establishments in this direction, but if so, we are very anxious to get in communication with them and exchange information on the results of our experiments and tests. I earnestly believe and am optimistic enough to say that this principle can be used to very good advantage in many other branches.

Cylinder Casting Inspection

Mr. Fors described two inspection devices used by his company for inspecting cylinder castings. The first is a rough inspection fixture which checks a number of items on the casting such as cylinder wall thickness; finish allowances for machining; location of bosses, cylinder bore and value seat cores, and various other diversions. One of these fixtures is furnished to the foundry and has resulted in much less scrap work and a second fixture, equipped with adjustable location points, is used in the machine shop.

The second fixture described is used for checking the depth of combustion chambers and their relation to each other. This fixture also is used by the foundry and has been found to result in such accurate castings that machining of the combustion chamber has been practically eliminated.

Better Results From Machine Tools a Matter of Cooperation

Automobile manufacturers should show more appreciation for efforts of machine tool builders, says speaker.

IN the relationship between the automotive and the machine tool industry, the problem of successful machine tool operation is not the special obligation of either industry but is essentially a mutual concern. Best results are to be anticipated through the joint efforts of the machine tool designer and builder on one side and the foreman and the operator on the other side.

An apparent failure at the first attempt on the part of the machine tool builder is not justification for throwing him out and repeating the process with another builder when either a new machine or a specific production problem are under consideration. Both builder and buyer have an investment in the first attempt; a slight alteration or correction may mean the successful solution of the difficulty, while the shift to another source means lost time and the sacrifice of the initial investment for both parties.

No general practice or law for the installation of special or standard machines can be advanced as the individual characteristics of the job, the whole product and policy of the concern making the product are the determining elements. Transfer of skill, which is the fundamental note of modern manufacture, also applies to the machine tool designer and also to the executive control of the machine's operation in the plant of the purchaser.

These, with a brief discussion of the characteristics and value of diamond pointed tools, were the high spots of the machine tool session.

Papers by O. C. Kavle and E. R. Stoddard were presented. The former was entitled "Fitting the Machine Tool to the

W. G. Careins, chairman of machine tool session

Job," and the latter "What Goes Wrong With Machine Tools in Automotive Production." Mr. Kalve also reviewed his experience with diamond tools, stating that there is almost no limit to the possibilities of this type of tool. Cuts must be very light but the speed can be very high. As a trimming or forming tool, the diamond point will cut hardened tool steel very satisfactorily. While the speed is not an important factor, cooling, as in any form of metal cutting, is of great value in prolonging the life of the tool between grinds. Too much must not be expected of the diamond tool. It

A paper on "Fitting the Machine Tool to the Job" was read by O. C. Kavle at the machine tool session

is not a hogging tool but better adapted to finishing operations requiring sustained accuracy. Mr. Kavle has used diamond points with a width of ¼ in. as lathe tools. The diamond is mounted in a soft steel carrier which is brazed to a standard lathe tool shank. Diamonds are not uniform and up to date no method of insuring high-quality with resultant durability as a cutting tool has been established.

In illustration of his paper Mr. Kavle showed about thirty installations of special machines or unusual fixture applications. Most of the machines were of the vertical type in which the feed is obtained by a cam. Multiple spindles or heads accompanied indexing fixtures in order to reduce the ratio of handling to operation time.

Mr. Kavle said in part:

"The importance of preliminary planning is not generally appreciated. It often results in great savings in time in production work, of floor space occupied by the machinery, and consequently of money. As production increases in volume, the quality of the article produced improves, because with larger production more money is available to devote to bettering the methods and to the building of better machines for doing the work.

"Unfortunately, the manufacturers in the automotive industry are, in general, unwilling to pay the necessary costs of developing special machines, notwithstanding the savings they produce, and do not always seem to realize that any machine-tool builder, in developing such a machine, may not always get it exactly right at first.

"In such a case they are too prone to think that he has failed and to go to some other machine-tool builder with the problem, perhaps only to have another failure, whereas the first builder, by reason of his first failure, is in better position to build the machine right the second time, and at least cost.

"We believe that the automobile industry has come to that stage in its production where the radical changing of design is becoming less and less each year and the production manager can consider more simplified production in his plant. The tendency in a great many cases has been to buy large, complicated machines to perform operations that could be done on much simpler units, because the machines have been stock products. The use of smaller and simpler machines not only effects a saving in power required to drive them but may also save floor space to such an extent in some cases that it may mean avoiding the expense of erecting new factory buildings.

When one becomes familiar with the lapping process, all machined surfaces seem poor when checked with a lap; even the finest finish that the grinder can impart is a very poor surface from the lapping point of view.

"If any doubt exists in the mind of anyone who is not familiar with the lap finish that there is danger of charging the bearings with particles of abrasion, he can easily convince himself whether this occurs or not by watching the finish that is being produced. A surface that has a tendency to charge always has the appearance of a frosted or ground glass, while the high-quality finish that is free from any charging or embedding of abrasive in the bearing has the clear bright appearance of the looking-glass surface."

In the discussion of the Kavle and the following paper, E. F. DuBrul, manager of the National Association of Machine Tool Builders, again emphasized the necessity for appreciation of basic economics by manufacturers in both fields. The machine tool builder must develop his product incessantly and the place to do this work is where production occurs, in the plant of the customer. While this is the obligation of the machine tool builder, Mr. DuBrul said, the automotive manufacturer can not forget that the customer always has to pay for development in any field, but closer cooperation will cut out much of the waste which is occasioned at present.

Based on many years' experience in the job of keeping machine tools in operation, Mr. Stoddard has classified the chief sources of trouble into three groups. Of unusual interest is the fact that he rates machine design and construction third in importance. Following the segregation of the sources of trouble are discussions and recommendations which will tend to eliminate some of the difficulties arising in each classification.

Chief Causes of Failure

The chief causes of failure of machines in the production line are:

1. Lack of lubrication.
2. Overload, carelessness and dull tools.
3. Poor design and construction.

In discussing these reasons for failure he mentioned the following solutions for group 1. Machine tools should be designed as far as possible with central oiling systems which supply all bearing surfaces. The practice of many machine tool builders in scattering oil holes all over the machine is one of the chief factors contributing to failures due to faulty lubrication. Operators on piece work will not hunt out these holes and in many cases can not find them after the machine is operated for a short period and is covered with oil and chips. The Studebaker Corporation, where Mr. Stoddard is engaged, equips all machines having inferior lubrication with sight feed positive oilers which hold a supply for at least a day's operation. Copper tubes extend from these oilers to all bearings. Where oilers are used they should be protected and equipped with traps which will keep chips out.

Commenting on group 2, he stated that failures arising in this class can be reduced by clamping the work securely before starting operation. Chips and surplus

stock should be cleared off the machine. Sharp tools are absolutely essential and hard stock or castings should be thrown out. Wrenches, clamps, bolts, nuts, etc., should be removed from the machine when not in use and placed where there is no possibility of falling into the mechanism of the machine. And finally, lubrication must be remembered. Self oiling loose pulleys should be fitted to the countershaft or on the main spindle when the machine is drawn directly from the line shaft.

Regarding the third class, the problems of which are up to the machine tool builder—he stated that control and clutch design should be improved. In too many machines it is possible to engage mechanisms which conflict and smash the machine. Shear pins which will prevent damage in case of stalling or jamming should be used more liberally. Not enough consideration is given to clearing either work or chips. The chip problem is particularly troublesome in almost all classes of machines. Instead of clearing away, the chips remain close to the tool and consequently get on the ways and help to wear them out. Ways should be protected by covering them.

Parts of a machine which are not required for the set-up in a production run should be removed and stored in containers. These containers should be individual and stored carefully to facilitate later use or application to the particular machine.

In conclusion, Mr. Stoddard said, the responsibility for successful machine tool operation devolves upon the designer and builder of the tool and with them, with equal responsibility, the foreman and the operator in the shop where the machine is installed.

V. P. Rumely, chairman of the committee which was responsible for the production meeting and the program which made it a success

Material-Handling Equipment Saves More Than Labor Cost

Various other economies made possible by utilization of conveyor systems. Mechanical details discussed.

THE many ways in which conveyors of various types can be adapted for uses in automotive plants other than for assembly work, with many illustrations of how such special applications have been made, constituted the major part of the papers and discussion of the conveyor session.

A paper, prepared by Paul Phelps and N. H. Preble of Mechanical Handling Systems, Inc., and read by Mr. Preble, consisted mainly of a large number of practical examples taken from existing installations where conveyor equipment of one type or another has been adapted to meet peculiar conditions and to solve handling problems of particularly difficult nature.

Examples were shown of conveyor systems which are used in handling raw materials, material in process, finished parts to the assembly lines and for final assembly. The point was emphasized that the prospective purchaser of mechanical handling equipment should not rest his judgment upon the possible saving in direct labor costs alone but also should bear in mind that there are other savings made possible by the use of such equipment which, while hard to evaluate accurately, may often be of much more importance than the item of direct labor costs.

The second paper, presented by Clarence A. Brock, Miller Hurst Corp., contained much practical information in regard to the advantages and disadvantages of various types of chains and drives as employed on conveyor equipment. Mr. Brock brought out the point that although nearly all conveyors of the power type are operated by chains the particular kind of chain which will give the greatest satisfaction is very much influenced by the service to which the conveyor will be put. For example, enameling chains require great strength, large live pin bearing area and small mass per unit, while the typical monorail conveyor chain must possess reasonable lateral flexure for traveling in curves in the vertical plane.

THE paper by Mr. Phelps and Mr. Preble stated in part:

The production of the modern automobile, while presenting many complex problems, can be reduced in principle to a certain few fundamental operations. These operations may be roughly and briefly outlined as:

1. The receiving and storage of raw material.
2. The transportation of this material to the machine shop, forge, foundry or other manufacturing department.
3. The machining, forging, or otherwise fabricating of the individual parts.

4. The transportation of these parts to the sub-assembly.

5. The sub-assembly operations, such as motor, axle, transmission, body assembly and the like.

6. The transportation of the various sub-assemblies and finished parts to the final assembly.

7. The final assembly, testing and shipment of the completed car.

In all these operations mechanical handling systems play a major and most important part, for transporation in one form or another is almost as big a factor as the actual making.

When we consider that the cost of an electrical horsepower employed in the moving of material is roughly a few cents an hour, while the man horsepower will cost in the neighborhood of 50c an hour, we can immediately visualize important possible cost savings. In addition, the indirect savings in improved manufacturing conditions may easily be even more important.

Handling Rough Castings

An instance of this is shown in an installation of conveyor equipment for handling rough castings from the receiving dock to the machine shop in an axle plant. All incoming stock must be received from the outer of three spur tracks. The center track is largely taken up by switching, while the inner track must be reserved for outgoing shipment. Formerly all castings were handled literally hand to hand, either through or around cars from the receiving dock to the machine shop. Two conveyors were installed which have replaced all of this hand handling and resulted in labor savings which paid for the entire installation in a matter of a few months. Further, there is no possibility of delay in the flow of the required parts.

Another raw stock handling problem is illustrated in a body plant. Here seat cushions are received on the ground floor, and must be carried to the sixth floor for upholstering. These cushions are received by motor truck and while light are bulky, and if handled by elevator would seriously interfere with the transportation of other material through the plant. The conveyor was installed to meet this situation. Cushions are hung on hooks, carried outside the building and across the roof to the upholstering department. In this instance no very startling saving in labor costs were effected, but a traffic congestion which was extremely serious was completely relieved.

In general it should be recognized that any system of floor trucking is almost sure to produce one or more tight spots where congestion and attendant delay will occur. Also floor space represents a capital investment which should be productively utilized. By some system of mechanical handling, congestion of this sort can often be avoided and the floor space left clear for productive operations.

These are merely two cases of stock handling. Other problems can perhaps be better served by gravity rollers, cranes or hoists, or different adaptations of the conveyor principle.

The concentration of sub-assemblies and parts at the final assembly line, frequently presents a difficult problem. In one method of handling motors they are transferred from the assembly conveyor by means of a hand-pushed trolley system to the storage loop in a dynamometer room. As wanted they are picked up by air hoists on trolleys running over the test stands, and carried into position for testing. After test, other hoists pick up the motors and transfer them to another monorail which runs alongside the silent test booths with a track into each booth. After silent test the motors come out on the same track, pass through a paint booth, and then under a crane over the storage racks. Here they are stored as required until transferred again by a second crane to monorails passing over the final assembly lines. Front and rear axles are brought in by truck and also carried over the assembly conveyor by means of monorails.

In one of the new body plants put into operation this spring, which produces an all-steel body with high temperature baked enamel finish, enameled before assembly, all transportation of parts is by means of monorail conveyors. The general layout of the plant provides for the stamping and press work on the first floor. After certain operations have been performed, all parts are hung on four conveyors running up to the fourth floor, where the continuous enamel ovens are located. After enameling, the parts are again hung on a second series of five monoveyors which carry them down to the second floor where the bodies are assembled ready for shipment. Additional lines are provided to transfer the various parts from sub-assembly operations to final assembly conveyor, and one line runs outside of the building to bring in to the proper point the paint stick returned from the trim department located in another building. At all points after the press operation, parts are carried overhead on slat conveyors.

Conveyors provide both transportation and final assembly. They illustrate the possibility of construction with a chain running on edge. There are three separate conveyors, two located on the floor carrying bodies received from the body plant just described. Each of these lines has a chain length of approximately 2300 ft. with an effective carrying length of about 1800 ft. Trim and assembly operations are performed as bodies pass along the line. The third line runs overhead, and serves purely as storage and for the transportation of bodies received complete from outside sources. The conveyor chain used is heavy 6 in. pitch, forged chain, with hinged pusher dogs and carrying shoes bolted into the chain links. At the turns it is guided by rollers mounted in castings set close together to produce nearly a true arc at the turn. The chain runs between two angles which also serve to guide the steel paint stick upon which the body is mounted. At the drive sprocket the chain has a 180 degree wrap, and then drops through the floor to a counterweighted take-up to care for accumulated slack. The return chain to this point where the lead is picked up is carried on the ceiling of the floor below. This type of construction will frequently make possible the solution of an awkward problem. It should be noted, however, that a chain running flat can be offset without difficulty if the radius of curvature is great enough.

Large Indirect Returns

The actual dollars and cents savings produced by these various installations cannot always be determined. Often the indirect returns in improved conditions, increased production and the like, may be even greater than the direct labor saved. In general, however, the return obtained from the investment in mechanical handling equipment is surprisingly large. A recent conversation with a plant engineer disclosed the fact that a conveyor installation costing over $80,000, had fully paid for itself in less than six months' operation, and was at that time saving about $800 a day, a return of about 300 per cent annually on the initial capital expenditure. Such returns are by no means uncommon. I might mention one sub-assembly conveyor costing installed about $2000, which effected a saving in direct labor alone, sufficient to pay for itself in the first two weeks in its operation. You would grab at the chance of a safe return on your money

of 10 per cent a year—isn't it well worth while considering the installation in your own plant of equipment certain to give you a much larger return?

Conveyors Used in Automotive Industry

MR. BROCK'S discussion of "Conveyors Used in the Automotive Industry," was in part as follows:

The plans for conveyorizing a given manufacturing process consist of listing the successive operations with respective rates of production and spaces required; determining the suitable types of conveyors; planning to keep as many consecutive operations as possible on one conveyor without rehandling; considering the available buildings with a view to convenience and economy; and finally co-ordinating the system.

Common types of conveyors adapted to the industry are: floor conveyors to push lines of bodies; canvas and rubber belt conveyors to handle bulk materials, upholstery and packages; open wire mesh belt conveyors for metal parts washing machines; trolley conveyors for overhead delivery; double strand conveyors for dipping and drying, and for bench height assembly lines; drag flight conveyors from raw bulk materials fed to numerous bins from the conveyor trough; gravity rolls to move work between machines; wood and steel apron conveyors to handle parts and boxes; and revolving platforms to rotate groups of production machines in turn to the successive operators when more than one operation is performed on a given machine.

Most of the above power driven conveyors employ chains. However, the necessary conveyor chain specifications vary. For example, the typical enameling conveyor requires chains having strength to take the load, large live pin bearing area to stand the wear at numerous bends, and small mass per unit of length in order to absorb as little oven heat as possible.

The typical monorail conveyor requires chain capable of reasonable lateral flexure for traveling along curves in a vertical plane.

The conveyor handling gritty substances must have large protected pin bearing area and mass at the joints, and perhaps large drag surface area.

Steel bar, bushed chain is strong, wears well, can be made of accurate pitch, and is adapted to rollers. Forged chain may be designed very strong and light, may be made detachable and of few parts.

The sliding friction coefficient of conveyor chains, either loaded or unloaded, dragged on horizontal steel track without rollers or appreciable lubrication is about 20 per cent of the vertical gross load on the chain when the chain is in motion.

Ordinary chain rollers add life to the chain, and give a coefficient of friction of about 15 per cent for 1½ in. rollers and as low as about 6 per cent for 6 in. rollers with plain bearings. These figures vary greatly with conditions. The starting load on conveyors may range from 50 per cent to several hundred per cent above normal running load.

Conveyor chains should probably never be run at greater working stress than 20 per cent of the ultimate strength even at low speeds and with heat treated chain of high elastic limit. Usual practice would be at a less stress, perhaps 10 per cent of the ultimate strength. Automatic takeups to allow for expansion and contraction of long conveyors may be of the gravity type, in which case the slack is taken up by a counterweighted carriage, or by a mere sag in the chain as it leaves the drive sprocket.

Horizontal drive chains operating on horizontal shafts run best with the tight side on top. They then run free on the sprockets, avoid kinks in the chain, and prevent interference of strands on long, slack chains.

Sprockets Must Fit Chain

Conveyor chain sprockets usually have cast teeth. Sprockets must fit the chain, the chain being considered as the standard. When sprockets wear seriously, the root circle grows smaller, the chain settles into this smaller circle, and the pin centers fall below the original pitch circle. The chain is thus working on tooth spacing which is nearer the sprocket center, and therefore shorter than the original chordal pitch.

Drive sprockets running at considerable speed should have 12 or more teeth to prevent shock due to unevenness of drive. Very slow speed drive sprockets may successfully run with as few as six teeth.

Clarence A. Brock described various conveyors used in automotive work

Eugene Bouton, chairman of the conveyor session

Paul Phelps, co-author of paper read at conveyor session

Roller bearing idlers run best without lubrication about 600 deg. Fahr. and require very little attention. They can stand temperatures up to 800 deg. Fahr., but the bearings should be installed with the end and bore clearances specified for the particular temperature by the bearing manufacturer.

The automotive industry almost always demands enormously greater service of a conveyor during a part of its life than could be determined at the time of its installation. Usually this demand is in the form of increased speed of travel. In the case of oven conveyors, the time in the oven tends to determine the speed of the conveyor, but the oven time principle is nevertheless often violated when production requires. Consequently a conveyor drive should be reasonably adjustable or quickly convertible to the possible demands of speed.

Constant and Variable Speed Drives

Drives may be classed as constant speed and variable speed. An economical constant speed drive for a heavy, slow speed conveyor with horizontal drive shaft consists of a motor directly connected to an enclosed gear reducer with roller chain reduction to head shaft through a shear pin.

A reducer and chain reduction in series is considered more economical than a high ratio reducer and large flexible coupling on the head shaft. The chain reduction is a flexible connection in itself and permits the motor and reducer to be located at any one of several positions relative to the drive shaft. Also, it is more economical to change sprockets than reducers if speed alteration is ever required.

The shear pin is more nearly certain of effect when installed at the slow speed end of the reduction train since the inertia of high speed members might be sufficient to wreck the conveyor even after the pin had actually sheared.

Remote control push buttons should be placed at strategic points to stop a conveyor instantly should occasion demand. Limit switches should be used where they may prevent injury to men or property. A simple form of safety switch is wire stretched across an open space and arranged to pull a switch in case a man or object should be drawn into danger.

Variable speed drives may be classed as mechanical, electrical and hydraulic. The mechanical variable speed transmission most used is of the Lewellen or Reeves type, and consists of a belt running over adjustable pulleys which virtually change ratio of diameters. Adjustment of speeds near zero cannot be obtained, but ratios between highest and lowest speeds obtainable on some models of this type are as great as 8 to 1.

The electrical variable speed devices may be divided into those that can be adjusted to give: 1. Continuous definite speed regardless of load. 2. Continuous definite speed at constant load only. 3. Definite travel regardless of load, but with pulsating speed.

The first may be an adjustable speed motor, such as the 3-phase squirrel cage motor having the stator specially wound to be connected in as many different manners as there are speeds on the control. Three and four speed motors are commonly used. No speeds between these definite adjustments are obtainable with this type motor. This variable speed motor is useful where nice adjustments and timing are not necessary, and where safety demands direct coupling as on a continuous body lowerator.

The pulsating speed control is a separate device from the conveyor motor, and changes that motor speed from full to fractional speed, or even to a stop during adjustable periods of a minute to give any average r.p.m. desired between full speed and zero. This variable speed pulsating control is more expensive than the common size of mechanical control when one conveyor only is in question, but it becomes economical when one control only may handle more than one conveyor of a co-ordinated system, and it is considered useful where unevenness of speed is not objectionable.

Conveyors are used in some plants as pace makers in production. In at least one such plant, variable speed drives are adjusted on all conveyors to give a definite, balanced day's output. The respective drive adjustments are then locked in place, and the conveyors are kept at capacity. The scheme seems to be very satisfactory in all respects.

The hydraulic transmission using oil as the transmission medium has been extensively used by the Government for the training of heavy guns. One maker recommends such a transmission for industrial use except for very low speeds at which it gives an unsteady drive on his particular transmissions. This type transmission has the advantage of allowing one or more driven ends to be run at various places, all from one pump end. However, if several conveyors be run from such individual drives connected to one pump end, and their speeds be co-ordinated by simple throttle control, this co-ordination of speeds will not remain constant on the same adjustment if the ratios of loads on the conveyors be changed.

A typical mechanical variable speed conveyor drive consists of a motor of about 1100 r.p.m., a silent chain reduction to a variable speed transmission of the Lewellen or Reeves type with constant speed shaft at about 350 r.p.m., a flexible coupling to enclosed gear reducer, and a final roller chain reduction through shear pin.

A portion of the machine tool exhibits at the National Steel and Machine Tool Exposition in Chicago last week

Rapid Advancement of Design Seen in Machine Tool Exhibits

Practically every phase of manufacture and machining of metals shown at Steel and Machine Tool Exposition. High speed production operations demonstrated in many cases.

IN the National Steel and Machine Tool Exposition held under A.S.S.T. auspices on the Municipal Pier practically every phase of the manufacture and machining of metal was shown in comprehensive fashion without any of the gadgets or parlor tricks which sometimes mar the tangible commercial value of showings of this kind. The magnitude, scope and value of the show is crystallized in the statement of one executive that "Any manufacturer who fails to send either his product or his men here is passing up a tremendous opportunity."

Approximately 350 exhibits occupied more than 13,000 linear feet of floor space along two aisles which extended the length of the pier. A round trip through the show brought a succession of ideas concerning outstanding features. These came in rapid succession, tool steels, small tools, hardening materials, furnaces, instruments for every application, machine tools large and small for production, tool and maintenance service, cleaning compounds and appliances and handling equipment. And of still greater importance, practically all of these were shown in operation or under operating conditions. One after another of the exhibits contained machine tools and other appliances in actual operation on regular work and in many instances in continuous high speed production.

From the angle of automotive production, there were no sensational new machine tools although several makers showed recent additions or refinements. However, the entire exhibit served to clinch the idea of the rapid advancement of machine tool design. Nearly every exhibitor featured the use of ball and roller bearings or the forced lubrication of plain bearings where they are required. Individual electric drive was required by the conditions of the exhibit but the hastily constructed belt guards and motor mountings of even a year ago were conspicuous by their absence. Anything but individual motor drive is practically an exception in practice as demonstrated at this show.

Machines of all types were equipped with control and stop arrangements which lift them from the old fashioned standard machine class and put them almost on a par with specialized tools for cyclic operation. Even the grandfather of them all, the old fashioned planer, has taken its place in this class.

No longer is the machine tool a hard and fast conception of cast iron, cold rolled shafting, some brasses and a miscellaneous lot of bolts, nuts and motions. Hydraulic feed is used extensively on such machines as planers, disk grinders, cylindrical and internal grinders, heavy duty drills, multiple spindle drills and broaching machines.

Electric Control a Feature

Along with the adoption of the electric motor, electric control is beginning to take its proper place. Several tapping machines were striking examples of the simplicity of design which results from the use of reversible motors and correlated electric control. Some of the high speed drill presses are being simplified by the inclusion of four speed alternating current motors with the changes being effected by self-contained electric controllers.

On the whole, the machine tool seems to be growing up. Turret lathes were particularly impressive by their massive construction and milling machines are in the same class. Automatic lathes for turning comparatively short bar work were in great evidence. Monarch, LeBlond,

Another view of machine tool section of National Steel and Machine Tool Exposition on the Municipal Pier, Chicago

Pratt & Whitney, Jones & Lamson are some of the names represented in this class.

Automatic machines were represented by National Acme, New Britain, Brown & Sharpe, Cone and Cleveland and in practically every instance these machines were engaged in turning out the regular run of work at a high production rate.

While the entire show was intensely interesting, automotive men were attracted largely by the production

Charles M. Schwab, one of the interested visitors at the exhibit, donned a suit of overalls and tried his hand at a bar job

exhibits. While a few of the machines in this class were engaged in work from other fields, the type of work was comparable to that of the automotive shop.

In the space belonging to the Crankshaft Machine Co. of Jackson, Mich., four cylinder crankshaft pins were being turned in a multiple tool lathe in which the tools follow each pin through its rotation around the crankshaft center. In the adjoining space belonging to the Walcott Machine Co., crankshaft cheeks were contoured in a lathe of somewhat similar characteristics. Also a Melling camshaft lathe was turning cams and bearings on a six cylinder camshaft and a Walcott gear grinder was operating on four pitch hardened gears. A short distance down the aisle, Bethel Player had a crankshaft lapping machine which was lapping the rod and line bearings of a six cylinder, seven bearing crankshaft. In this process cast iron laps are used in conjunction with an abrasive compound.

Tappets and valves were ground in a Heim centerless grinder shown by Cincinnati Grinders, Inc. Bilton Machine Tool Co. showed a four station Productomatic milling machine engaged in slotting roller type tappets at the rate of 360 pieces per hr. Sundstrand showed a stub lathe turning gear blanks and LeBlond showed an automatic lathe doing similar work. At the Gardner Machine Company's exhibit, ringwheel grinding was used for facing manifolds while another double end machine was in operation on the ends of coiled springs.

Jones & Lamson converted one corner of its space into a typical production shop. Two Fay automatic lathes turned out cluster gear blanks complete as far as turning is concerned. J and L lathes also were engaged in chucking bar work on a similar basis.

Kearney and Trecker showed a new No. 3 milling machine contouring large rectangular aluminum castings in an air operated fixture which was driven against cams to produce a rectangular line of travel as regards relationship with the cutter.

Bullard, in addition to the vertical turret lathe, showed their latest machine, a 6 in. Multaumatic at work on packing glands. This machine incorporates all of the features of its larger predecessors.

Cincinnati Milling Machine Co. had two No. 3 millers, a vertical and a horizontal, producing malleable pipe couplings of the split and bolted type while a third, the 24 in. automatic machine was equipped with an indexing fixture for gashing two differential side gear blanks simultaneously under conditions of full cyclic operation.

The Anderson Die Machine Co. exhibited a small multiple spindle tapping machine of novel design equipped with a dial feed. The Consolidated Machine Co. operated a two spindle continuous rotary mill on the gasket surface of cylinder heads. Landis Tool Co. had a crankshaft grinder in operation. Diamond Machine Co. showed a larger surface grinder. Steering knuckles were ground at the Norton exhibit in a machine equipped with two wheels of different diameter so that the large and small spindle bearings were finished simultaneously.

Scrap from these and many other machines including the planers and shapers and heavy duty engine lathes was passed through the scrap crusher shown by the American Crusher and Machinery Corp.

Some New Machines

Among the new machines, the Monarch automatic lathe and Bullard Multaumatic have been mentioned previously. The Ohio Machine Tool Co. showed a new knee type milling machine equipped with individual motor drive and a heavy cast overarm which is guided in a vee slot at one side and rests on a flat surface at the opposite side. The new Cisco tapping machine combines a mechanical drive for rotating and reversing the spindle with a pneumatic control of the spindle travel. The Racine Tool and Machine Co. showed a new power hack saw in which the saw blade is fed positively and produces chips comparable to those of milling machine operation.

In the tool and maintenance field, large internal grinders were shown by Heald, Greenfield Tap & Die Co. and Bettendorf. The Morton Manufacturing Co. had a new heavy duty cut shaper engaged in dressing down forging die blocks. Several of the tool companies featured parabolic cutters for slabbing work on die steel.

The trend of modern manufacturing practice is indicated by the interest in electric furnaces and pyrometer equipment. In addition to a continuous conveyor type furnace, Holcroft and Co. exhibited a large circular continuous furnace in actual operation. George J. Hagan Co. of Pittsburgh also showed a continuous electrically heated circular electric furnace in which all of the handling of incoming and outgoing material is performed mechanically. Although the electric furnace is coming and has arrived at many plants, interest in the gas furnace has by no means subsided as was shown by the new developments in the continuous and individual type of the American Gas Appliance Co. and others.

Steels and their treatment as evinced by the number and variety of exhibits could have absorbed the entire week for one individual. Jones & Laughlin exhibited several automotive parts made from their new Jalcase steel which is a case of hardening stock of improved machining characteristics. Also it is stated that some economy follows in the heat treating department due to a slightly higher rate of carbon penetration.

A new type of metal working material and its heat treatment were advanced by the Pyrotung Mfg. Co. of Chicago. It is understood that this material is one of the alloys containing elements not common to ordinary high speed steel. At this booth statements from various

automotive production men were shown to bear out the claim that tools made of this material operate from 5 to 16 times as long between grinds as does the usual tool steel. In general practice, any blank of specified size suitable for the desired tool is supplied by this company. Then the purchaser has the tool roughed out and returns it for treatment after which the tool is returned for final finish sizing.

An unusual method for forging worms was shown by the Fulton Drop Forge Co. of Canal Fulton, Ohio. First the worm is blanked in the usual hammer die and then is passed across into a contouring die where the teeth are practically roughed out and the metal is flown so that the fibers run up into each tooth through its entire length and bend back into the middle of the blank. Where a worm forged under the ordinary process broke at 60,000 lb. in a tensile test, a contour forged worm does not break under a load of 100,000 lb.

The Chambersburg Engineering Co. exhibited its new model B 12,000 lb. steam drop hammer which was recently put on the market. This hammer embodies several major improvements designed to insure the permanency of alignment and to reduce operating and maintenance costs.

Steel Treaters Discuss Topics of Automotive Interest

Wearing characteristics of metals used for gages, dies, etc., considered. Chromium plating suggested for gages.

At the eighth annual convention of the American Society for Steel Treating, held in Chicago Sept. 20 to 24, a number of subjects were discussed which appeared to be of particular interest to the automotive men attending. Among the more important of these were discussions upon the fatigue strength of metals and its relation to tensile strength and discussion of the wearing characteristics of metals used for gages, dies and similar services.

One paper pointed out that there is a definite relation between tensile strength and the Brinell hardness number only when the material being tested is of a homogeneous nature. If this condition is not present this relation probably does not exist because the tensile strength is an average for the complete section while the hardness test is a surface test only.

This departure from a straight line relationship in the tests made by the author of the paper, J. M. Lesselle, Westinghouse Electric & Manufacturing Co., was also associated with a decrease both in tensile strength and in the ratio of endurance limit to tensile strength. This he explained on the basis of there being residual stresses present. As a result of his work, Mr. Lessells believes that great caution is necessary in attempting to determine endurance limit values from tensile strength or Brinnell test data for steels which have a Brinell hardness of 350 or more.

Stainless Iron

In a paper prepared by P. G. McVetty and N. D. Mochel, also of the Westinghouse Company, on the subject of the tensile properties of stainless iron and other alloys at high temperatures, it was brought out that stainless iron and hot rolled Morel metal show very good tensile properties up to 752 deg. Fahr., but above this point their strength decreases and at 932 deg. they become brittle.

Considerable interest was displayed in the material used for dies, gages and other services where non-deforming steels are necessary.

From the results of tests made at the Bureau of Standards and reported in a paper prepared by H. J. French and H. K. Herschman, a question was raised as to the advisability of continuing the present practice of utilizing file-hard steels for plug gages. In the discussion which followed the paper there did not appear to be a very general acceptance of this suggestion, many of the metallurgists present believing that under operating conditions a file-hard steel is necessary. It was brought out, however, that irregardless of the steel used the finish given to the surface of the gage has a very great influence upon its effective life.

Alloys for Gages

For the construction of gages—both master and service—of delicate dies and of other units where close adherence to dimensions is an important factor, the addition of a small amount of alloy such as manganese or manganese and chromium was recommended by Edgar C. Bain and Marcus A. Grossmann—the former of the Union Carbide and Carbon Research Laboratories and the latter of the United Alloy Steel Co.

These men stated that when 1½ per cent of manganese or 1 per cent of manganese and ½ per cent of chromium is added to the steel it hardens deeply and, although the dimensions of the steel vary greatly with the drawing temperatures, a proper drawing temperature can be applied so that the final size will be very near that of the original work.

D. J. McAdam, Jr., of the U. S. Naval Engineering Experiment Station presented a paper on how corrosion fatigue of metals is affected by chemical composition, heat treating and cold working. Some of the conclusions which he drew from his experimentation were that sorbitizing heat treatment does not improve the corrosion fatigue limit of any but low carbon steels; that for carbon steels and for alloy steels having about the same corrosion resistance the corrosion fatigue limit varies surprisingly little; that it appears possible that the corrosion fatigue limit is much more dependent upon ductility than is the endurance limit; and that since corrosion fatigue depends upon two factors—corrosion intensity and a stress range—it seems probable that the corrosion fatigue limit depends upon a strength factor as

well as upon corrosion resistance. He concluded that the effect on the corrosition limit of the physical properties determined by the usual tension and impact tests is almost negligible in comparison with the effects of corrosion resistance.

Mr. Lessells, in his tests regarding the relation of fatigue strength to tensile strength, compared tensile strength, Brinell hardness and fatigue limit of two steels. The results obtained led to tests to determine if residual stresses were present and it was found that residual stresses of 110,000 lb. per sq. in. were present in the outside layers of a .42 per cent carbon steel which had been normalized at 1580 deg. Fahr. quenched in a salt solution at 1562 deg. and drawn at 210 deg. for one hour. Residual stresses of 30,000 per sq. in. were found in the same steel when it had been quenched at 1435 deg. and drawn at 590 deg. for 30 min. while there were none found in 1.0 per cent carbon steel.

Mr. Lessells did not state that these residual stresses are strictly comparable with the discrepancies found in the straight line law but only that they do confirm that when such departure is obtained residual stresses are present.

In the paper prepared by Messrs. French and Herschman on the wear of steels with particular reference to plug gages, an interesting machine was described which was developed to simulate in the laboratory the operating conditions under which plug gages are used. It consists, essentially, of a device for repeatedly inserting plug gages into split rings, representing material to be gaged, and permits control of a number of important variables such as the pressure between the gage and the work, the presence or absence of abrasives, lubricants, etc., and the metals from which both the gages and the material to be gaged are made.

Tests were made on a number of steels and wherever possible two heat treatments were applied to each steel to give file-hard and file-soft steel, since the question has been raised by gage makers and users whether file hardness was necessary and a criterion of good wear resistance.

Because of the rapid formation of an oxide film on the gage and a consequent tendency for it to seize, it was found impossible to run the test dry, and water and an abrasive mixture were employed in the tests. In the water tests it was found that file-soft, high carbon steels, as well as chromium ball race steels, are about two or three times as resistant to wear as are the same steels in a file-hard condition. When abrasives were used in the tests, however, there was found to be no such divergence between the wearing qualities of the two types of steel—the number of holes gaged per ten-thousandth inch of gage wear being nearly the same for file-hard and file-soft conditions.

The explanation for this offered by the authors of the paper is that the penetrating power of the abrasive used was so high that the difference in toughness between file-hard and file-soft steels is not enough to make much appreciable difference in their respective wearing qualities. In the metal-to-metal tests the particles of metal detached from the gage itself and from the work constitute the abrasive medium. They do not have the cutting power of emery and resistance to their action becomes largely a matter of toughness. The file-soft steel, being tougher than the file-hard material, thus wears better under such conditions.

This assumption was further borne out by tests made with chromium plated gages. Chromium plating shows high resistance to penetration but is brittle. Compared with steel gages chromium plated gages showed a remarkably longer life in metal-to-metal wear tests but only a slight superiority in the abrasive tests. From this the authors suggest that for ordinary gage work chromium plating appears to offer promise.

Mechanical Inspection Devices Are Described at Meeting of A. S. M. E.

Machine Shop Practice Division hears of new machines which check six dimensions at a single operation.

AT a meeting of the Machine Shop Practice Division of the American Society of Mechanical Engineers, held Thursday afternoon in connection with the meetings of the A.S.S.T. and the S.A.E., some points in connection with machine inspection devices, of particular interest to automotive men, were brought out by E. D. Hill, Western Electric Co.

Many of the products made by this company are produced in large quantities but are of such nature that a high degree of accuracy is necessary. To solve the inspection problem arising from such a situation Western Electric has developed a large number of machines which check parts automatically for one or more characteristics, thus not only avoiding errors introduced by the human element in all annual inspection work but very greatly speeding up the process and lowering its cost over manual inspection.

Nearly all of the machines described by Mr. Hill were of very specialized nature. It is of interest, however, to realize the extent to which inspection can be done automatically by machines. Among the machines described were some which checked as many as six dimensions or characteristics at a single operation. Length, width, diameters—both internal and external, weight and a number of special characteristics, such as the strength of a soldered joint, were all inspected by various types of machines.

Another valuable characteristic of this type of inspection which also was discussed at the inspection session of the S.A.E. production meeting was the pace setting possibilities of such devices. The inspection machines operate at a constant speed so that, even if inspection is not carried out in the production line as suggested by Mr. Frauenthal at the inspection session of

the S.A.E. meeting such work as must be done manually upon the parts by inspectors may have its rate of speed set by the rate with which the machines perform their inspection operations.

A particularly interesting device of this nature was demonstrated by Mr. Hill. It makes possible inspection by the action of light upon a photo electric cell. Although this device is now being used by Western Electric only for testing insulation resistances, he pointed out that it has almost limitless possibilities in other lines of work.

For example, many tests are made by observing the movement of a light ray as influenced by the readings of a galvanometer. Mr. Hill said that if the photo electric cell is covered and light admitted to it through a small slit, a buzzer or light signal can be connected up with the cell to show automatically whether or not the part tested is within predetermined limits.

Another interesting paper was presented at the A.S.M.E. session by H. K. Keevir, McDonald Machine Co., on the possibilities of standardizing the units employed on machines utilized for special work.

Other papers were read by Eugene C. Clark, Chambersburg Engineering Co., on drop forging steam hammer handles, and by Hugo Diemer, LaSalle Extension University, on foremanship training.

The FORUM

Front Axle Design

Editor AUTOMOTIVE INDUSTRIES:

In the August 5 issue of your magazine there appeared an article by P. M. Heldt, on "Designing Front Axle Ends to Support Braking Stresses," on which I would like to offer the following comments:

Mr. Heldt states that the flanges in I-section are of no torsional use. As a matter of fact, the section modulus for a rectangular section is

$$z = \frac{w^2 h}{4.5},$$

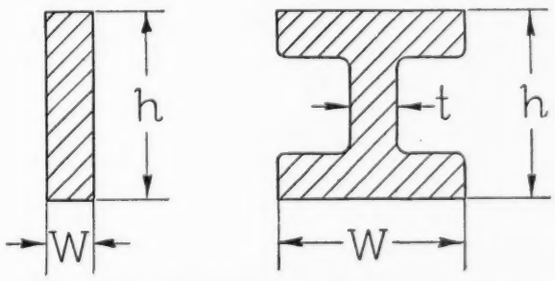
which is the same as that shown by Mr. Heldt.

The section modulus for an I-section, however, changes to:

$$z = t^2 \left(\frac{h + 2\,(w\text{-}t)}{4.5} \right)$$

The latter formula takes into consideration the full width of both flanges, and checks very closely with actual measurements taken on both sections.

The section next to the spring pad, toward the steering



knuckle, should be stiff enough to take care of the continuous shocks in the horizontal direction, as well as the vertical load and twisting in case of front wheel brakes. In fact, some of the old axles, designed for vertical loads only, showed a constant set which, of course, caused tire and steering troubles.

In order to prevent the setting, and at the same time keep the weight of the axle down, an I-section seems to be the only satisfactory solution, since the stiffness increases with the cube of the flange.

At the end of the axle beam, where, in case of front wheel brakes, pure twisting occurs, the circular section would be most appropriate. The question of just how strong an axle should be, is purely empirical. I have yet to see a front axle which broke in two due to weak design, excluding faulty forgings. It is not the strength, it is the stiffness which is required in a successful axle design, and in some cases we are already advanced to the point of expressing comparative designs more on basis of deflection than of stresses.

CHAS. R. HARRMAN.

Authorities differ a good deal as to the torsional strength of I-sections. The formula used by the writer, according to which the torsional strength of an I-section is no greater than that of a rectangular section of the same height and of the same width as the web of the I-section, is given in Kent, Tenth Edition, page 371. The formula quoted by our correspondent is found in Hutte. All authorities agree that it is practically impossible to derive a rational formula for the torsional strength of any complex section. The only sections that lend themselves to simple analytical treatment of torsional stresses are solid circular and annular sections.

Some experimental work that supports the view that the torsional strength of an I-section depends merely upon the web extended to the top and bottom of the section has been done by Prof. Bach of Stuttgart and is recorded in his book on *Elastizitat* und *Festigkeit*. The cross sections used in Prof. Bach's tests were of about the same proportions as those commonly used in front axles; that is, the height of the section was 1.5 times the width and thickness of the web and flanges between one-sixth and one-seventh of the width and height, respectively. It was found that when the torsional moment reached a certain value, the four fingers cracked simultaneously from the outside. This cracking caused only a slight lowering of the torsional moment. If the experiment was continued the torsional moment could be increased (average of three experiments) about 18 per cent over that at which the flanges cracked before the test piece finally gave way.

The test pieces had solid rectangular ends, and the cracking of the webs occurred adjacent to these ends. Evidently, to get a better idea of the torsional properties of such sections, the change from the solid rectangular to the I-section should have been very gradual.

Bach gives a general formula for the torsional strength of solid circular, annular and rectangular sections, in which a different constant is used according to the form of the section. By applying this formula to the results of his test on I-sections he obtains for the calculated ultimate strength of the material, figures covering a range of 1:5, which shows that this formula is not applicable to I-sections.

Resistance to bending stresses in the fore and aft directions is important and can be readily secured by means of a rib between the spring pad and the upper portion of the section outside the pad. This rib should preferably be somewhat more liberal than indicated in the drawings accompanying the article.—P. M. H.

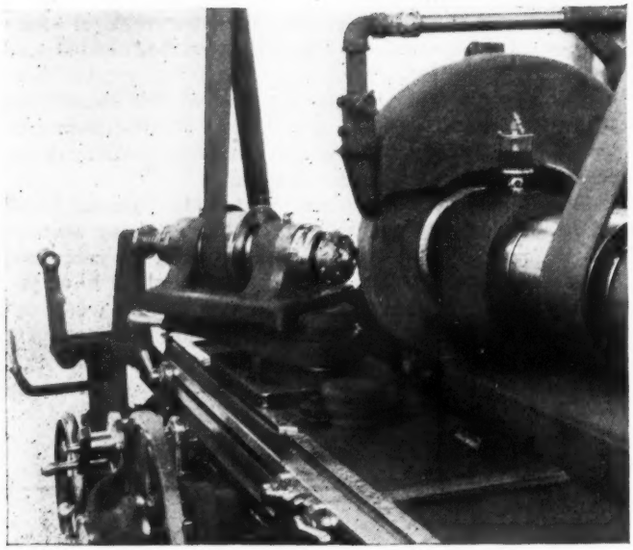


Fig. 17. Grinding back of differential pinion to a radius (Norton)

(Continued from page 543)

duction, and gears were ground only if a batch proved unusually noisy. It was therefore more a salvaging than a production process.

Since that time about half a dozen different machines have been developed in this country by which the tooth form is generated by the flat side of the wheel. Grinding is gradually coming to be a recognized method of finishing for transmission gears. Where formerly these gears were rought-cut and finish-cut before hardening, they are now hobbed, then hardened and finally ground. Distortion due to quenching is thus eliminated and the gears operate much more quietly. It is claimed, moreover, by the grinder manufacturers that the process is cheaper than the previous one, as the finish-cutting process is eliminated and the cost of the grinding wheels is no greater than that of the cutters required for the finishing process. This claim would seem to be supported by the fact that the grinding process has been adopted for finishing the gears on some of the lower priced cars. Some of the saving is in the handling, as with ground gears it is not necessary to match pinion and gear.

To demonstrate the advantages of grinding gears after hardening, it was necessary for the grinder manufacturers to develop instruments which indicate any inaccuracy in tooth outline and indexing, and a number of very interesting devices of this type have been worked out during the past several years.

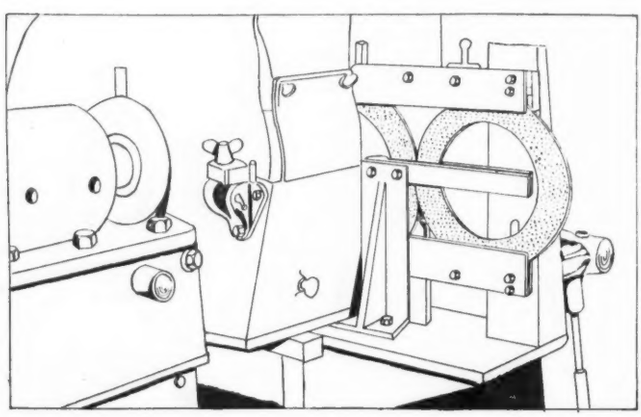


Fig. 18. Fixture for grinding molded asbestos disks in Gardner disk grinder

Spline Grinding

IN order that the gears of the transmission may mesh together noiselessly at high speeds, it is essential that the sliding member be well supported on accurately fitting splines. Both the shafts and the gears are heat treated after machining, and the heat treatment tends to distort the parts, so, if an accurate fit is wanted, the splines must be ground. There is no particular difficulty in grinding the splines on the shaft, as this can be done by means of a formed wheel. The grinding of the internal splines of the gear, however, is a rather difficult proposition. An equipment for effecting this operation and at the same time grinding out the hole has been rigged up in the Packard plant. As shown in Fig. 16, the machine used is a Heald Duplex grinder. One head carries the wheel for the internal grinding of the hole, while the other carries—on an arm extending lengthwise of the machine—a smaller wheel for grinding the splines. The hole is 1.3 in. in diameter and 2.5 in. long, and it has six splines. The gear is held in a special fixture, being located by a plug entering between two splines, and drawn against its seat by two hook bolts. The locating plug is then withdrawn and the hole ground by means of the wheel carried by the head on the left.

The splines are ground with a wheel of about 1⅜ in. diameter which is run at a very high speed by a round belt running in a groove at the middle of the wheel face. The drive of this wheel is quite a problem, owing to the very high speed of rotation and the small "pulley" diameter, and a solid leather belt without joint is used. The work is indexed from spline to spline and the wheel fed sideways against the spline to ensure the proper width of slot. Grit is drawn off by a suction device. Both the hole and the splines are ground in one setting.

Fixtures and Attachments

GRINDING operations have been greatly facilitated by the development of numerous attachments and fixtures for use with grinding machines. The Gardner Tool Co., Beloit, Wis., developed a fixture for grinding asbestos fabric disks in its double head disk grinder. It consists of two steel guide bars fastened to two opposed guide members, rigidly supported at the front and rear of the machine. Rings are fed through the fixture by hand. Both sides of the ring are ground, with a tolerance on thickness of 0.005 in. Steel disk wheel grinding heads of 20 in. diameter are used, both movable and provided with micrometer adjustment. While grinding they are held stationary by springs.

Norton this year brought out a pneumatically operated foot-stock which is said to be particularly useful in grinding ball races and roller cups in gangs on an arbor. The foot stock can be controlled either by a lever or a treadle. Treadle control has the advantage that it leaves both hands of the operator free to manipulate the work.

Another novelty in the attachment line is a pneumatic steady-rest. It acts as a support for the work and prevents vibration of same. Vibrations set up by the cutting action, particularly on long work, have a percussion effect on the wheel, and if they can be damped out the finish will be improved and the wheel face will stand up longer.

EDITORIAL

Non-Standard Rear Treads

EVER since the obsolescence of the high-perched type of passenger car, which permitted of building the rear seat out over the wheels, it has been a problem to provide a seat of sufficient width to be comfortable for three full sized people. At one time it looked as though the outcome of the situation would be that rear seats would be arranged for two instead of three people, and cars would be built in two, four and six, instead of two, five and seven-passenger models. However, the five-passenger and the seven-passenger types had become so well established that manufacturers were loathe to give them up, and four and six-passenger models remained exceptions.

Additional difficulties have been introduced in recent years by the adoption of balloon tires. The width of tread is figured to the center of the wheel or tire, and if the width of the tire is increased the permissible width of the rear seat is decreased by the same amount. The larger the car the more difficult the task, because the buyer of a large car naturally expects particularly roomy and comfortable seats, while, on the other hand, the width of tire required increases with the weight of the car.

Designers of large cars now are beginning to meet the difficulty by widening the tread at the rear. In the past it has been generally considered essential that a car which was to be sold in all parts of the country should have the standard tread of 56½ in., so it could readily follow horse wagon tracks. However, our network of hard roads is increasing continually and the need for traveling in deep ruts made by farm wagons, etc., arises quite rarely, especially in the case of the more expensive cars, a good proportion of which sell in the large cities, in the neighborhood of which the roads are particularly good. Moreover, with balloon tires and modern springing it is not so essential to follow in the ruts when traveling over dirt roads as it was with the older, poorly sprung vehicles.

Buses and Mass Transportation

THERE are some who still refuse to believe that buses can satisfactorily handle the bulk of passenger traffic in a metropolitan area. Yet it is done. Some recent figures from London on the subject are illuminating.

The figures show that last year 45 per cent of all the passengers carried by London's transportation system patronized buses; 28 per cent used the railroads and 27 per cent were handled by the street railways. The totals were as follows: Buses, 1,671,000,000; railroads, 1,049,000,000; street railways, 979,000,000.

Even as far back as 1913, buses were competing most successfully with the railroads and surface trolley lines of London. In that year they were handling as much traffic as the railroads and in the distribution of the total business were only 4 per cent behind the trolleys.

A comparison of the 1913 and 1925 figures show how consistently the buses have gained ground against the older forms of transport. During the 12 years the total increase in London passenger traffic of all kinds was 63 per cent. In the same period, however, bus traffic increased 127 per cent, the railroads showed a gain of only 45 per cent, and the trolleys finished a poor third with a gain of but 21 per cent.

A similar shift in the traffic picture is taking place in the United States at present and possibly 12 years from now buses will be playing as important a part in the handling of mass transportation in our leading cities as in London, where there is conclusive proof that buses are more popular—and hence it may be assumed more efficient—than any other form of travel

Railroads Accept the Bus

THE American railroads seem to be in the bus business to stay. Reluctant a few years ago to admit all of the possible efficiencies of this new type of passenger carrier, a large number of them today are admittedly looking forward to the continued and increasing operation of buses as an integral part of their business of transportation.

This condition is emphasized by the formation last week of the Railroad Motor Transport Conference, composed of the representatives of 40 Class 1 railroads of the United States, Canada and Australia. The organization is designed to be a clearing house for information and experience on bus operation among railroads. An important railway executive is said to have stated informally at that conference that the railways never would willingly have engaged in the bus business unless they had been driven to it in self-defense, but that they have taken it up as a necessary means of protecting their investment.

No more practical evidence of the stability of the present economic position of the bus could be found than the current investigations and activities of the railroads along bus transportation lines. The motor bus has become a permanent, essential part of our transportation system.

AUTOMOTIVE NEWS SECTION INDUSTRIES

Philadelphia, Pennsylvania

Thursday, September 30, 1926

Limited New Car Stocks Uphold Production Pace

PHILADELPHIA, Sept. 30.—With many leading lines of automobiles continuing to be bought in large volume, the industry will go into October on much the same production basis as maintained in September. Curtailed schedules set up in a number of plants are largely overcome by continuing heavy operations in a majority of the leaders. Sales of cars in the medium priced and higher priced lines are holding closest to early year records and in some instances are higher.

Dealer stocks of new cars continue to be below normal for the industry as a whole and with retail buying holding up through the month there will be no marked accumulation. This will permit of a continuance of good manufacturing operations throughout the fall as there will be no marked let-up in factory pace until retail stocks approximate the usual 30 days' supply.

It is noteworthy that the wave of fall selling is being accomplished without the aid of such special sales inducements as lower prices, high trade-in allowances or extended terms. Likewise there are very few fall shows or special drives being negotiated. The buying is simply a response to the appeal of the fall cars with an application of steady dealer effort. That this is the case, especially with the better priced lines making improved showings, indicates that the industry is in a very firm position.

Truck producing companies are finding a steady market for truck and bus products. Sales both in the United States and abroad are increasing but competition for business is marked. As in the domestic field, higher priced passenger car lines are enjoying the best export trade.

Schwab President of A.S.M.E.

RICHMOND, VA., Sept. 28—Charles M. Schwab, chairman of the Bethlehem Steel Corp. and former chairman of the board of the Stutz Motor Car Co. of America, Inc., was this week unanimously elected president of the American Society of Mechanical Engineers in convention here. Mr. Schwab has been a member since 1899 and in 1918 he was made an honorary member, in recognition of his contributions to the development of engineering.

GM Open Cars Sales Drop

NEW YORK, Sept. 29—Sixteen per cent of all cars sold by General Motors Corp. in July this year were open cars, compared with 46 per cent in July, 1925. The average for 1926 to date is below 20 per cent, compared with 37 per cent in 1925 and 57 per cent in 1924.

Many Repossessions Aftermath of Storm

Flooding of Florida Used Car Market With Check on New Cars Seen

JACKSONVILLE, FLA., Sept. 29.—The automobile business probably will suffer more than any other as a result of the recent tropical hurricane which swept South Florida, according to Claude Nolan, prominent automotive distributor of this city who has just returned from the storm-stricken areas.

"I do not mean that the immediate loss is greater," said Mr. Nolan, "although this is heavy. The real problems, however, will come as an aftermath in the form of difficult credit situations.

"During the storm thousands of privately owned motor cars were destroyed or damaged. Hundreds of the owners, who made their purchases on the time-payment plan, will be unable to meet their obligations, allowing the car to be repossessed by the finance corporation through which they consummated the purchase.

"The best possible outcome for such a situation, so far as the dealer is concerned, will be the repossession of many cars which will be placed in his used offerings.

Service Facilities Overtaxed

"Then to aggravate conditions, it is physically impossible at this time to recondition all damaged cars. This is due both to the great number of automobiles and to the impaired facilities of service stations and independent garages.

"Many dealers had their buildings damaged beyond repair and several will not open for business again, from present indications. There is no doubt but that South Florida will be flooded with used cars during the next few weeks which quite naturally will tend to decrease new car sales."

MACK CREDIT CHECK SEEN AIDING MARKET

NEW YORK, Sept. 27—Announcement this week that Mack Trucks, Inc., had adopted a policy of more stringent credit terms in the sale of its products created widespread interest in the industry. The curtailment of sales to the class of purchasers that insist on very small down payments and long terms for settlement, it was held, should prove a big step toward stabilization of truck and bus merchandising.

Although there was some disposition in Wall Street to regard the move as likely to reduce appreciably the volume of Mack sales, temporarily at least, in the trade it is estimated that transactions on terms considered unsound were never more than 10 per cent of the total, and the losses on these transactions tended to be excessive. As Mack has its own finance subsidiary, these losses were borne by the company and they should now be eliminated, the benefit to be reflected in earnings.

Canada Total Shows Slight August Gain

OTTAWA, Sept. 29—Production of automobiles in Canada in August totaled 15,261 units, which compares with 15,208 in July and with 8963 in August, 1925. Passenger car production totaled 12,769 and trucks and buses 2492.

For the first eight months of the year the cumulative total is 155,347 units, which compares with 114,650 in the first eight months of 1925. In point of value the 1926 production to date exceeds the 1925 eight months' valuation by about $21,000,000.

Imports of cars and trucks into Canada in August totaled 3083. Against these 3080 cars were exported leaving the apparent Canadian sale to dealers 15,264 as against 5950 in August last year. For the year to date the apparent absorption of vehicles by the Canadian market totals 131,985 as against 80,607 in the same period in 1925.

Michigan Sales Increase

DETROIT, Sept. 27—Retail sale of motor cars in Michigan for August, greatly exceeded the corresponding month a year ago, registration figures reveal. The total passenger car sales for the month were 17,183 while a year ago they aggregated 13,876. Sales for the first eight months of 1926 total 147,323 while a year ago sales aggregated 136,000.

Ford Plants Adopt Five-Day Work Week

With Increased Production Facilities Can Meet Demand in Shorter Period

DETROIT, Sept. 28—Under plans of Ford Motor Co. as officially announced by Henry Ford, the company has now arranged its production facilities so as to meet all normal requirements in five working days weekly. Saturday and Sunday in the Ford factories and all other related properties with the exception of the Ford-owned Toledo, Detroit & Ironton Railroad, are to be days of complete cessation of operation, this policy being effective immediately.

According to Mr. Ford plans are now being worked out whereby the rate of payment of workmen for five days will approximate the former six-day rate. In his statement he did not definitely declare that the company would arrange its pay-roll on this basis but said it would be possible for employees to earn as much in five days as they formerly did in six owing to the fact that the five-day production rate would equal the former six-day rate.

The company has been operating mainly on a five-day basis or less since the completion of its large expansion program in 1924. During that year plants and equipment were brought to a 10,000 car day basis, a rate that has not yet been required by buying demand. Operating the plants at capacity on five days a week or less has been sufficient to meet buying. With the Ford market as extensive as at any previous time the company has facilities to build approximately 200,000 cars monthly, working five days weekly. Demand for more than a year has been considerably below this point.

In his statement Mr. Ford declares the country is ripe to adopt the five-day work week in all industries. He declares it his belief that additional well-paid leisure time is necessary to permit of absorption of the additional supply of manufactured goods.

Speedway Representatives Advance Corporation Plan

NEW YORK, Sept. 29—Charles H. Schwab and representatives of several eastern motor speedways met at the Ambassador Hotel here today to continue discussion of a proposed corporation to take over and operate the speedways. Mr. Schwab is one of the principal owners of the Amatol (N. J.) speedway. Among those who attended the meeting were Robert P. Good and E. J. Bigley, both of Altoona, Pa.; C. W. Roberts of Charlotte, N. C.; and Jack LeCain of Salem, N. H.

It is understood that plans have progressed to the point where the formation of a corporation, probably in Delaware, was discussed. Mr. Schwab, who is reported to be taking a leading part in the proposed merger, said that only tentative plans were discussed today.

Mr. LeCain stated that appraisals on the speedways are now being made and that final decision on the formation of the corporation awaits the clearing up of this and other details. Mr. Schwab's personal attorney, he said, would handle the incorporation.

Delco-Remy Sales Centralized by G.M.

NEW YORK, Sept. 28—The Delco-Remy Corp., latest subsidiary of General Motors Corp., which will take over the sale of products of the Dayton Engineering Laboratories Co. and Remy Electric Division will have headquarters at the General Motors Building in Detroit. The manufacturing administration of the two divisions was centralized under one head five months ago and the new subsidiary will perform a similar function by correlating the selling activities.

In announcing the new selling organization it is pointed out that each division manufactures a different type of starting, lighting and ignition system designed to meet differing needs and that for that reason the two are not competitive.

Former sales policies will continue under the new company without change. Existing contracts with car manufacturers will remain in force as heretofore and each division will retain its former field men who will continue their customary contacts with the trade. The plan will have no effect on the function of United Motors Service. C. E. Wilson is president of the company. G. B. Stone, vice-president and general sales manager, will be in charge at Detroit.

Warner Joins Studebaker, Veal Takes Research Post

NEW YORK, Sept. 29—John A. C. Warner who has had charge of the meetings and sections department of the Society of Automotive Engineers, has resigned to accept a position with the research department of the Studebaker Corp. of America, effective Nov. 1. Mr. Warner's successor has not yet been named.

C. B. Veal of Manly & Veal, has accepted the position of research manager of the S. A. E., succeeding Otto M. Burckhardt, who left the S. A. E. sometime ago to join Buick Motor Co.

250,000 Cars Stolen in 1925

WASHINGTON, Sept. 28 — Nearly 250,000 automobiles, valued at $218,000,000, were stolen in the United States during 1925, the research division of the American Automobile Association discloses after an exhaustive survey.

The figures assume a recovery of 80 per cent of the cars, leaving a dead loss to motorists of $35,000,000 for vehicles, plus the loss incurred in the repair of recovered vehicles and the time spent in establishing ownership after recovery.

Business in Brief

Written exclusively for AUTOMOTIVE INDUSTRIES *by the Guaranty Trust Co., second largest bank in America.*

NEW YORK, Sept. 30.—The volume of distributive trade increased last week, notwithstanding the almost wholly unfavorable influence of the weather. The Florida disaster, extreme heat through other parts of the South and West and the cold wave in the latter part of the week combined to restrict business in the localities affected. Industrial production continued in large volume, although some curtailment was reported in the steel industry. Commodity prices resumed a downward trend, while stock prices moved irregular with a slight tendency toward lower levels.

CAR LOADINGS

Car loadings of freight in the week ended Sept. 11 (a holiday week) numbered 1,031,081, as compared with 975,499 in the corresponding period last year.

BANK DEBITS

Bank debits to individual accounts reported to the Federal Reserve Board for the week ended Sept. 22 were 4.2 per cent larger than the total for the preceding week and 8.5 per cent above that of a year ago.

OIL PRODUCTION

A further decline in production of crude petroleum occurred during the week ended Sept. 18, output averaging 2,172,400 bbl. daily, as against 2,184,350 bbl. a week earlier and 2,131,600 bbl. in the corresponding period of 1925. A number of reductions in prices of crude oil and gasoline were reported last week.

FISHER'S INDEX

Fisher's Index of wholesale commodity prices stood at 147.8 last week, as compared with 148.3 a week earlier and 148.1 four weeks earlier. The wholesale price index of the Bureau of Labor Statistics declined from 150.7 in July to 149.2 in August.

FEDERAL RESERVE STATEMENT

Bills and securities held by the Federal Reserve banks declined $78,800,000 during the week ended Sept. 22, gains of $96,100,000 in discounts and $7,900,000 in open market purchases being more than offset by a decrease of $182,900,000 in holdings of Government securities. Note circulation decreased $8,000,000, deposits $85,300 and reserves $7,400,000. The reserve ratio rose from 71.6 to 73.1 per cent.

During the same period, loans of reporting member banks declined $57,000,000, with decreases of $44,000,000 in loans secured by stocks and bonds, $12,000,000 in loans secured by Government obligations and $1,000,000 in "all other" loans. Investments declined $34,000,000 and net demand deposits $371,000,000, while borrowings from the Federal Reserve banks increased $86,000,000. Loans to brokers and dealers, secured by stocks and bonds, made by reporting member banks in New York City declined $58,000,000.

Retail Sales Hold Tire Production High

Factory Earnings Improve With Steady Operation—Equipment Prices Cut

AKRON, Sept. 30—Sales and production of automobile tires during September were somewhat below the record breaking levels of August, but total business has held up better than was expected. The usual seasonal recession in the industry has not been pronounced this fall, owing to the large potential demand existing for tires among car owners who had deferred making needed purchases in the spring and summer.

Stability and firmness of the crude rubber market within the past few weeks also has been a factor in keeping the retail tire business on an even keel. It has served to dissipate more than anything else rumors of a forthcoming downward revision in tire prices, which were heard earlier in the month.

The only change in tire prices since July 6 has been a 5 per cent reduction on original equipment sold to automobile manufacturers. This was announced recently by the Firestone Tire & Rubber Co. and was followed by other companies handling this business. It means little, however, as the price of tires to dealers and the public is not affected, and the reduction is not sufficient to bring about any changes in car prices.

Tire production in the Akron district fell off after Labor Day, but picked up again later in the month, and now is only 5 or 10 per cent below August records. Original equipment business is naturally not as heavy as it was in August, but sales of tires through dealers have held up better than was expected.

Inventory Position Improved

Profits of most of the rubber companies this month were excellent, owing not only to their large sales but to improved inventory positions. High priced rubber and finished materials have been worked off, and at present rubber prices satisfactory earnings can be made on tires. Many manufacturers took advantage of the lower levels prevailing in the crude rubber market last month to contract for their requirements six or eight months in advance, it is learned.

Officials of the Goodyear, Goodrich, Firestone and Miller companies here report their high priced inventories have been wiped out, and their crude material costs are based on rubber at current levels or lower. These companies have slowed down their operations slightly, owing to a slackening in demand for tires from the motor car manufacturers, but retail business continues heavy.

Most of the medium sized and smaller companies, which sell their products exclusively through dealers, still are operating at capacity, and some are reported to be behind on orders.

FORD LOSES HEARING ON NAME OF CIGAR

WASHINGTON, Sept. 27—The Commissioner of Patents has denied the appeal of the Ford Motor Co. for a re-hearing in its action against John A. McAdoo, to prevent McAdoo from using the trademark "Ford" for his cigars. The decision, refusing cancellation of McAdoo's registration, holds that the Ford Motor Co. is not injured, in that it has never appropriated the trade-mark in the manufacture of tobacco products, and in that its products are in every respect dissimilar from McAdoo's.

Chandler Equipment Adds 26 Per Cent to Capacity

CLEVELAND, Sept. 29—Chandler has increased its production capacity 26 per cent during the first eight months of this year by the erection of a new building and the installation of new machinery, equipment and factory methods.

Among the new features is a $100,000 conveying, spraying and drying system which was recently installed at the 131st Street plant. At Euclid Avenue plant a similar department was added and installed in a new four story building, 80 x 100 ft. Additional equipment for assembling and machining parts was added at both plants.

At the gear, heat treating and nickel-plating plant the capacity has been greatly increased through improvements to the equipment and increasing the polishing and plating department facilities to absorb such items as bumpers and bumperettes and other miscellaneous nickel parts which are now standard equipment on all Chandler cars.

Mexico Encourages Assembly

MONTEREY, MEXICO, Sept. 25—President Plutarco Elias Calles has just issued a decree which provides that spare automobile parts that are intended to be used for assembly in plants in this country shall be admitted at a 50 per cent discount of duty. A large assembly plant has recently been inaugurated in the vicinity of Mexico City for low priced cars and it is understood that others are being planned. Monterey is one of the places where it is expected a plant will be installed. It is the purpose of the government to encourage the sale of low priced cars in connection with the highway system.

F.W.D. Adds New Model

CLINTONVILLE, Wis., Sept. 27.—The Four-Wheel Drive Auto Co. has added a new 1½-2 ton. four-wheel drive truck known as the Model H to its line. It is similar to the Model B except that the 4x5 in., four-cylinder Wisconsin model SU engine is mounted in front of the dash instead of under the seat. Wheelbase is 121 in. and overall length 220 in.

A.E.R.A. Show Draws Big Industry Display

Buses and Parts Increase Space Holdings—Operation Papers Feature Program

CLEVELAND, Sept. 28.—The 45th annual show and convention of the American Electric Railway Association, to be held in the Public Auditorium here, Oct. 4-8, promises to exceed in importance and scope all former association meetings, with the automotive industry taking a more prominent part than ever before.

Over 118,000 sq. ft. of exhibit space will be available and 22 bus and truck manufacturers will occupy nearly 39,000 sq. ft. or 32 per cent of the total. In addition to the bus and truck exhibits a considerable number of the 225 exhibitors will be makers of automotive parts and accessories.

Papers to be presented at the convention of the A.E.R.A. and its affiliated associations include several which should be of interest to automotive men. Tuesday morning, Oct. 5, the general topic is "Street Congestion—Let's Reduce It". On Thursday morning Alfred H. Swayne, General Motors Corp., will speak on the subject "Provide Now for Future Transportation." A paper on "Bus Accidents—Their Causes and Successful Methods of Prevention" will be presented before the Claims Association on Monday afternoon.

The Engineering Association will listen to a paper on Monday afternoon on the design of buildings for maintenance, storage and operation of buses and the design of joint bus and rail terminals. Thursday afternoon the Committee on Bus Operation of the Transportation and Traffic Association will present its report.

Ruggles Shows New Trucks

SAGINAW, MICH., Sept. 25—District sales managers of Ruggles Motor Truck Co. were addressed by Joseph W. Fordney, president, and Albert Sleeper, a director, at the annual sales convention. Mr. Fordney is a former congressman from this district and was for a long time a national political figure, and Mr. Sleeper is a former governor of Michigan. Sales during the first half of the year were shown to have increased 24 per cent over the first half of 1925 with promises of further increases in the latter half. The company's new line of trucks which are soon to be publicly announced, were shown at the meeting and plans were made for a big sales campaign.

Link-Belt Adds 34th Office

CHICAGO, Sept. 28.—Link-Belt Co. has opened a new branch office in Utica, N. Y. which will be in charge of F. P. Herman, Jr. This is the 34th office, and the third within the State of New York, which the company is now operating.

Exports, Imports and Reimports of the Automotive Industry for August of Current Year and Total for Eight Months Ending August

	Month of August				Seven Months Ending August			
	Number	Value	Number	Value	Number	Value	Number	Value
	1925			1926	1925			1926
EXPORTS								
Automobiles, parts and accessories (total)	..	$27,920,768	..	$22,080,155	..	$208,737,643	..	$218,984,894
Electric trucks and passenger cars	4	8,235	15	16,552	84	139,026	65	97,236
Motor trucks and buses, except electric:								
Up to one ton, inclusive	..	..	..	..	..	..	..	..
Value up to $800, inclusive	5,406	1,824,649	2,897	1,343,370	25,112	8,978,954	33,429	14,373,564
Value over $800	274	309,769	179	195,312	1,986	2,150,330	1,805	2,106,307
Over one to 2½ tons	873	1,104,884	908	1,318,716	6,166	7,789,299	7,894	10,486,695
Over 2½ tons	171	488,991	158	513,366	1,048	3,154,237	1,476	4,620,856
Total motor trucks and buses, except electric	6,724	3,728,293	4,142	3,370,764	34,312	22,072,820	44,604	31,587,422
PASSENGER CARS								
Passenger cars, except electric:								
Value up to $500, inclusive	15,081	5,615,575	5,485	2,130,794	66,109	24,213,200	64,808	24,688,762
Value over $500 up to $800	5,005	3,518,818	5,399	3,581,195	40,091	28,323,412	45,606	31,010,234
Value over $800 up to $1,200	4,575	4,811,408	4,014	4,179,237	37,501	39,258,508	37,606	39,621,244
Value over $1,200 up to $2,000	1,414	2,126,890	869	1,344,446	14,070	20,968,688	7,953	12,183,089
Value over $2,000	444	1,244,507	363	957,377	3,485	9,513,776	3,661	9,974,914
Total passenger cars, except electric	26,519	17,317,198	16,130	12,193,019	161,256	122,277,584	159,634	117,478,243
PARTS, ETC.								
Parts, except engines and tires, Automobile unit assemblies	..	2,565,795	..	2,330,572	..	28,263,507	..	29,558,564
Automobile parts for replacement	..	2,688,877	..	2,686,293	..	18,711.440	..	23,851,450
Automobile accessories	..	766,151	..	688,182	..	5,698,447	..	6,562,690
Automobile service appliances (n.e.s.)	..	577,927	..	614,400	..	3,344,058	..	4,839,717
Station and warehouse motor trucks	15	16,066	9	9,589	211	154,543	116	121,288
Trailers	40	21,800	30	7,508	372	182,887	706	255,300
Airplanes	1	1,100	3	13,180	63	296,376	30	140,121
Parts of airplanes, except engines and tires	..	7,099	..	8,430	..	95,684	..	111,786
BICYCLES								
Bicycles and tricycles	628	17,290	326	8,915	5,355	141,713	3,766	111,916
Motorcycles	1,383	304,989	1,592	342,893	14,830	3,356,298	15,863	3,418,658
Parts, except tires	..	156,463	..	172,667	..	1,120,778	..	1,260,712
INTERNAL COMBUSTION ENGINES								
Stationary and portable:								
Diesel and Semi-Diesel	190	57,304	35	215,328	662	345,615	570	1,124,019
Other stationary and portable:								
Not over 10 HP	3,366	287,187	3,389	392,805	18,956	1,640,913	21,399	2,092,111
Over 10 HP	165	229,571	571	397,910	1,818	1,580,558	1,744	1,782,376
Automobile engines for:								
Motor trucks and buses	56	17,039	569	93,309	31,501	2,660,093	4,713	555,867
Passenger cars	7,800	829,180	5,490	701,464	81,268	8,914,726	94,738	9,293,422
Tractors	529	172,904	328	194,758	947	392,578	1,786	809,105
Aircraft	3	11,030	18	94,847	32	82,299	277	562,203
Accessories	..	..	..	..	..	..	..	..
IMPORTS								
Automobiles and chassis (dutiable)	65	104,439	68	112,709	399	715,039	461	829,109
Other vehicles and parts for them (dutiable)	..	48,648	..	23,164	..	524,355	..	95,088
REIMPORTS								
Automobiles (free from duty)	14	24,108	15	39,520	142	204,343	110	170,148

Willys Adds Coupster on Knight Great Six

TOLEDO, Sept. 29—Willys-Overland has brought out a convertible body model called the coupster on the Willys-Knight Great Six chassis. This model has a collapsible, coupe type of top construction held rigidly by heavy metal side bows hinged at the middle. Windows drop into the door and heavy posts at the front of the cowl act as the frame for the windshield and furnish a strong support for the coupe top when raised. The top material is weatherproof, rubberized fabric, gray in color and close-grained in texture. The windshield is in one-piece and a sun visor is permanently fastened to the windshield frame.

Below the top, the body is similar to the standard roadster on this chassis with rumble seat at the rear for two passengers and with entrance to the storage space in the rear from the back and also from a door opening on the right side of the body. The price is $2295.

To Show Electric Trucks

NEW YORK, Sept. 27.—The latest models of electric street trucks will be displayed at a joint exhibit at the New York Electrical and Industrial Exposition at Grand Central Palace, Oct. 20 to 30. It will be the first exhibit of its kind staged in connection with this exposition.

The trucks are being exhibited as a part of a co-operative market development program conducted for electric street truck manufacturers by the Society for Electrical Development.

Reo Offers Sedan Bus Carrying 15-17 Riders

LANSING, Sept. 25—A new 15-17 passenger sedan bus weighing 600 lb. less than the previous models and listing at $5100 has been added to its line by Reo Motor Car Co. The new bus is powered with the passenger car six-cylinder T-6 engine and has been developed especially for city transportation.

The bus has four doors, three being on the right side. The front door gives access to the two front rows of seats, the center door to the third row, and the rear to the rear seats. When used as a 15-passenger vehicle an aisle is provided and a seat is placed in front of the center door which has a safety catch. A trunk rack is mounted on the roof while a wicker hamper is provided at the rear for small parcels. Single balloon tires are provided on the rear in place of duals.

Navy to Buy 283 Planes

WASHINGTON, Sept. 29—The purchase of approximately 283 new planes is contemplated by the Navy Department during the next fiscal year, it has been learned. They will all be of the fighting type, and will be secured as a result of a flight test competition.

Pierce-Arrow Head Sees New Car Doubling Sales

NEW YORK, Sept. 27—Speaking of the outlook for the new high priced Pierce-Arrow Series 36 Dual Valve Six, Myron E. Forbes, president of the Pierce-Arrow Motor Car Co., who is in New York to supervise the formal introduction of the car, said:

"We showed the new cars privately to our distributing organization at a series of meetings held at the factory last week. As a result of orders placed by distributors themselves and of the considerable volume of sales they reported within a few days after returning to their territories, we can conservatively predict that we will sell a volume of high priced cars which will be double that of our former Series 33.

"We believe, too, that the tremendous interest which the Series 36 is creating will reflect itself in increased sales for our moderately priced line of Series 80 cars, which are being continued without change in price or design."

Wausau Gets Sav-Oil Ring

WAUSAU, WIS., Sept. 28—The Wausau Motor Parts Co., manufacturer of Wausau plain and PortOil rings, has become affiliated with the Sav-Oil Ring Mfg. Co., of Los Angeles, Calif., whereby the Wausau concern will manufacture and sell the Sav-Oil piston ring east of the Rocky Mountains.

Charles D. Hastings

DuBois Young

New chairman of the board and president of Hupp Motor Car Corp., Mr. Hastings taking the place formerly occupied by J. Walter Drake, now Assistant Secretary of Commerce. Mr. Young formerly was vice-president in charge of manufacturing

Loree Would Scrap 30,000 Miles of Rail

DALLAS, Sept. 28—Abandonment of 30,000 miles of railroad in the United States as a cancerous growth on the transportation system was advocated by L. F. Loree, chairman of the boards of the Missouri, Kansas & Texas and the Kansas City Southern Railroads at an Interstate Commerce Commission hearing on his application to operate these two lines jointly with the St. Louis Southwestern Railroad.

This suggestion came as an answer to the protest of short rail line representatives that his proposed merger would crush them. Asked how communities on these lines would be served if the rail lines were scrapped, he said:

"Principally by truck and passenger automobiles I think. But, however they are to be supplied they should not be served at the expense of other people's pocketbooks. The whole thing I wish to emphasize is that there is no reason for this socialistic idea of making the strong lines support the weak."

Under cross-examination Mr. Loree said that 4000 miles of the 30,000 miles which should be abandoned are in the southwest. "They are worn out tools," he said. "No one has any idea of the loss caused by these virtually dead lines."

R. E. Carpenter to Sail

NEW YORK, Sept. 29—R. E. Carpenter, vice-president and general manager of Spicer Mfg. Corp., will sail for Europe Oct. 2 to attend the annual general meeting of Hardy, Spicer & Co., Ltd., the British Spicer associated company. This will also be the occasion of an inspection of the new British plant at Birmingham.

Mr. Carpenter will attend the London and Paris automobile shows and will also study the European market in which the Spicer companies are participating increasingly.

Trucks Now Serving 500 P. R. R. Stations

PHILADELPHIA, Sept. 30—The hauling of less-carload freight is now being carried on by trucks on 33 routes of the Pennsylvania Railroad. Approximately 1000 miles of railway line is now being paralleled by trucks and some 500 railway stations are served. The motor truck operations average 2600 motor truck miles a day, varying as the trucks are manipulated to serve the operations of the various divisions.

According to the railroad, savings have been effected by the use of trucks and service to the public has been improved. Operation of through trains likewise has been facilitated by the elimination of interference with fast trains.

All of the truck equipment used is contracted for, being owned and operated in each instance by the largest trucking company in the vicinity where the truck service has been installed. Under the system used, freight from distant points is broken up at main terminal points, and instead of being reshipped in local freights to destination, the station nearest to the trucking service is used.

N.Y.N.H. Starts Truck Use

NEW YORK, Sept. 27—Award of five contracts to five trucking companies to deliver certain classes of freight by motor truck, which heretofore were moved by water, was announced by the New York, New Haven & Hartford Railroad.

M.A.M.A. Head Says 1926 Greatest Year

Parts Makers Enjoy Good Business With Improved Profits —General Situation Sound

BUCHANAN, MICH., Sept. 28—The year 1926 will prove to be the greatest in the history of the industry in the opinion of H. L. Horning, president of the Motor & Accessory Manufacturers Association and head of the Waukesha Motor Co. In summarizing the observations of the board members, he continued:

Parts makers have experienced their best business and profits have been fairly satisfactory. The country is at its highest state of prosperity and while lowering of commodity prices, strengthening of money rates, slight curtailment of installment selling and lower prices on farm products and other indications of local problems are apparent, there never was a time when so large a percentage of industries and commercial activities were in so favorable a situation in regard to volume and profit. While there is some tendency toward growth of inventories in all lines it is by no means out of proportion to the volume of business carried.

Mr. Horning said that one large car maker is departing from the traditional policy of manufacturing his entire product and is contracting with large parts makers to make parts for new models. Several other substantial orders along the same line will be placed, he said.

The truck industry is being put on a much sounder financial basis through elimination by several large manufacturers of excessive allowances for old trucks. Introduction of trucks in the National shows will give the parts builder a better opportunity to reach his market, said Mr. Horning.

M. A. M. A. Elects 10 Members

NEW YORK, Sept. 28—M. L. Heminway, general manager of the Motor & Accessory Manufacturers Association, announces the election of 10 new members, as follows: Bonney Forge & Tool Works, Allentown, Pa.; Brunner Mfg. Co., Utica, N. Y.; Columbus McKinnon Chain Co., Columbus; Fitzgerald Mfg. Co., Torrington, Conn.; Hershey Mfg. Co., Chicago; K-D Mfg. Co., Lancaster, Pa.; Kilborn-Sauer Co., Fairfield, Conn.; Marvel Products Co., Cleveland, and Milwaukee Die-Casting Co., Milwaukee.

Motor Wheel Net $450,000

LANSING, Sept. 28—Earnings of the Motor Wheel Corp. for the current quarter are estimated at $450,000, as compared with $417,890 in the second quarter. Officials estimate net earnings for the year around $1,900,000 which would amount to about $3.50 a share net on 550,000 common shares outstanding, and compare with $2,502,027, or $4.32 a share for 1925.

Hoover Sees Planes Increasing Rapidly

Predicts Growth of Commercial Carriers to 500 or 600 in Six Months

WASHINGTON, Sept. 28—"Extreme satisfaction" with the progress of commercial aviation in the United States was expressed by Secretary of Commerce Hoover in a review of aeronautics made on his return to Washington after a month's trip to the Pacific Coast. He predicted there will be 500 or 600 planes in operation for commercial purposes within the next six months. There now are about 150 planes in such operation.

"There is even more interest in commercial aviation than I had anticipated," Mr. Hoover said. "There is promise of more rapid development than our best hopes. This is especially true in the Pacific Coast and Rocky Mountain States, because of the great saving in time between long distances, which commercial aviation affords.

"Rapid advance of air transportation, however, will not have any great consequential effect on ground transportation for the present at least," Mr. Hoover said. He sees as the special field of commercial aircraft "the speedy transportation of high class and expensive goods," a service for which he predicts "an even greater future utility, because of its greater safety, for one reason.

"The recently organized civil aeronautics branch of the Department of Commerce now is devoting its attention to development of air facilities, such as airways, beacons, landing fields, etc.," he said.

MacCracken Outlines Needs

WASHINGTON, Sept. 29—In a statement dealing with all phases of commercial aeronautics, William P. MacCracken, Jr., Assistant Secretary of Commerce in charge of the newly organized Aeronautics Branch, goes into detail on plans of his organization.

The statement, a detailed one, deals principally with the need for greater aids to navigation, and chief place in this list is given to radio beacons and radio phones, so that flyers can be apprised in detail of weather conditions ahead on flying routes. Lighting of the airways and adequate weather communication between air landing stations also are listed as prime necessities for immediate development.

Says Value of Air Mail Must be Sold to Public

WASHINGTON, Sept. 28—A general and extensive advertising campaign to "sell" the air mail to the public is the greatest need of the air mail service today, W. Irving Glover, second assistant postmaster general, has declared discussing the growth of the transportation of mail by planes.

Mr. Glover declares that while civic bodies and commercial bodies, spurred on by civic pride, have guaranteed to give business to air mail contractors, "these pledges have fallen far short of fulfilment," despite which "the contractors have carried on and will succeed."

The business of air mail must be sold to the public "just as a toilet soap or similar article is sold," Mr. Glover believes, and he says this can only be done by advertising.

Goodyear Would Sell New Giant Airship

WASHINGTON, Sept. 28—A project to build for the United States Navy, the largest airship in the world, one that would travel six days without refueling, was discussed at a White House conference between President Coolidge and P. W. Litchfield, president of the Goodyear Rubber Co., it has been officially announced at the White House.

W. C. Young, manager of aeronautics for the Goodyear Company, accompanied Mr. Litchfield at the White House talk. In an interview after the talk, Mr. Litchfield predicted a great future for lighter-than-air craft, and stated that the proposed huge dirigible, now under construction, would demonstrate that the ocean can be crossed on a regular schedule and will give commercial aviation a tremendous boost.

Charles B. Burgess, Navy civilian expert, declared that the proposed dirigible, for which Congress will be asked to appropriate funds, would be of 6,000,000 cu. ft. capacity, three times that of the "Los Angeles," now the largest of its type. It would be designed for a flying radius of 8000 miles at a speed of 58 miles an hour. It is estimated that, if one were built, it would cost $5,000,000 and if two were constructed at the same time, they would cost about $4,000,000 each.

To Revive Parker Trucks

MILWAUKEE, Sept. 25.—The corporate title of the Parker Motor Truck Service Co. has been changed to Parker Motor Truck Co., Inc. The business was recently acquired by J. Grossmann and associates to resume the quantity manufacture of the Parker truck. For several years the business of the original Parker company, following the death of W. H. Parker, president and principal stockholder, has been operated merely as a service and repair concern, but production of complete new trucks is again being undertaken.

Kinite Names Sales Heads

MILWAUKEE, Sept. 28.—Kinite Corp. has made the following additions to its sales staff: Kenneth L. Clark will supervise the Michigan, Illinois, Indiana, Iowa and northern Missouri territory; R. H. Herbst will take charge of the Detroit office and will represent the company in Michigan, and P. L. Getzinger, with offices in Chicago, will represent the company in Illinois and Indiana.

U.S. Seeks Effect of Liberty Engine Sale

Plans Special Price to Aircraft Builders if Industry Not Sharply Disturbed

WASHINGTON, Sept. 29—A canvass of the automobile industry, especially those manufacturers engaged in the construction of aviation engines, has been ordered by the War Department, at the direction of President Coolidge.

Purpose of the survey is to determine whether or not the Government's proposed plan of selling a surplus of 12,000 Liberty motors will work a hardship on the aircraft engine building industry. If it does not the plan provides that these motors are to be sold to private aircraft builders at a considerable price reduction, as an inducement to stimulate commercial aviation.

A preliminary discussion of the plan was had this week between President Coolidge and Secretaries Hoover of Commerce and Davis of War Departments. The President was informed by his Secretaries that the Liberty motors are adapted for civil aeronautics and that they could probably be sold at a price below similar motors now being made.

The only consideration interfering with the sale, a White House spokesman said, would be the probable restraint that it might place on the aviation motor building industry, which the Government is anxious to maintain, it was said.

Improved Engines Favored

PHILADELPHIA, Sept. 30—Smaller lots of Liberty engines from war surplus stock have been offered to aircraft builders in the past and have found a ready market due chiefly to the fact that more modern engines were not available at comparative prices. Industry opinion is that at the present time these engines would not find as ready a market as it has been demonstrated cheaper to buy improved engines at higher prices than to attempt to operate with war-time engines at a lower initial cost.

S.A.E. October Meetings

NEW YORK, Sept. 29.—Sectional meetings will be held by the Society of Automotive Engineers during October as follows:

Oct. 4, Cleveland, What is the Field of Coach and Bus on Electric Railways, for Co-ordination, Alteration or Rail Replacement? Walter Jackson; Oct. 5, Buffalo, Quantitative Effect of Engine Carbon on Detonation, Neil MacCoull; Oct. 7, Detroit, Sound and Its Measurement, Floyd Firestone; Oct. 7, Indiana, Shimmy and Tramp; Oct. 8, Southern California, Testing of Gasoline and of Oil, R. W. Stewart; Testing of Engine and of Steel, T. A. Fitch; Oct. 12, Chicago, Outing and Factory Inspections; Oct. 14, New England, Brakes; Oct. 21, Metropolitan, Aviation, Lieut. G. O. Neville and A. G. H. Fokker.

Men of the Industry and What They Are Doing

Borah Joins Moon Motors as Assistant to President

J. C Borah, according to an announcement by Stewart MacDonald, president of the Moon Motor Car Co. of St. Louis, has been appointed his assistant. For the past two years Mr. Borah has been general sales manager of Victor Motors, Inc., St. Louis, from which he resigned to join the Moon organization. Previously he was general sales manager for the Traffic Truck Corp. of St. Louis. He is well known in the trade, particularly on the Pacific Coast, where he did special work for the General Motors Truck Corp. at Los Angeles

Mulch Rejoins DeVaux

R. H. Mulch has been appointed vice-president of the Durant Motors Co. of California in complete charge of sales at the Oakland factory which supplies all Pacific Coast states. He will be next in authority to Norman de Vaux, vice-president and general manager. The appointment is effective Sept. 27.

Mr. Mulch was associated with Mr. de Vaux when the latter was president of the Chevrolet Motor Co. of California and also when the latter assumed charge of Star car operations in the West. Mr. Mulch was called east by Durant three years ago and this is his first return.

Hoffman Visits Foreign Shows

Paul G. Hoffman, vice-president in charge of sales of the Studebaker Corp. of America, with Howard S. Welch, export sales manager, and Ralph De Palma, of the Studebaker engineering staff, were on the Mauretania this week en route to Europe where they will visit the London and Paris shows, and will study the European sales situation with a view to further development of the market for Studebaker cars.

Champion to Make Annual Trip

Albert Champion, president of the AC Spark Plug Co., will sail for Europe Oct. 2, on the SS Paris. It is his annual trip in the interest of the company's European factories, located at Birmingham, England and Paris. While abroad he will also attend the London and Paris shows.

A. H. Blanchard Goes Abroad

A. H. Blanchard, professor of highway engineering and highway transport at the University of Michigan, is sailing for Europe where he will devote several months to the investigation of highway engineering transport and traffic control problems.

Horner Succeeds Cullen

Leonard S. Horner has been elected president of the Niles-Bement-Pond Co., succeeding James K. Cullen, who resigned to devote his time to the Niles Tool Works of Hamilton, Ohio, of which he is president and general manager.

EDSEL FORD UNVEILS FIRST PLANT TABLET

A monument to the memory of the Ford Motor Co. will be unveiled in Detroit by Edsel Ford.

The monument will be a bronze tablet and will be placed on the Bagley Ave. building to mark the site where Henry Ford built his first automobile. The tablet is one of a number marking historical spots in Detroit which are being placed this month. The tablet reads: "This Tablet

"Marks the site of the birthplace of the Ford Motor Company. Henry Ford began experimenting with the automobile in a small workshop located here. He here produced his first car, a two-cylinder machine, mounted on a light chassis geared to rubber-tired bicycle wheels. Thirty years later the Ford Motor Company produced its fourteen millionth car."

Chamberlain Opens Chicago Office

P. E Chamberlain, for many years connected with the automotive industry in the distribution and sale of motor cars, is now vice-president and general sales manager of the Perfection Apple Service Co., Inc., with offices in the Arnold Joerns Building, Chicago. The company is building a nation-wide apple vending service through the medium of slot machines, and is backed by prominent apple growers and bankers of the Yakima district in Washington.

Goodman Heads Detroit Zone

A. G. Griffin has been appointed manager of the Chevrolet Motor Co. retail store in the General Motors Building, succeeding Arthur H. Goodman who has been promoted to the position of zone manager of the newly created Detroit zone. Harvey Tyrrell, whose sales ability has gained him the presidency of the Chevrolet "Seventy-two Car Club" will be Mr. Griffin's assistant.

W. H. Reese Joins Distributor

William H. Reese, for more than 10 years advertising manager of the Sterling Motor Truck Co., Milwaukee, has resigned to become associated with E. W. Rode, distributor of Sterling trucks at Buffalo, as sales manager. His successor has not been named.

Sloan Meets Ripley Points

A. P. Sloan, Jr, president of General Motors Corp., in an interview in the current World's Work, meets many of the points raised by Professor Ripley in his recent criticism of the failure of corporations give the public more information concerning the conduct of their affairs.

J. Hartley Phillips Joins General Motors Truck

J. Hartley Phillips has joined the sales and service organization of General Motors Truck Co., as assistant to Vice-President P. L. Emerson, in charge of sales. Mr. Phillips will have supervision over the Central States.

For 18 years Mr. Phillips was connected with the White Motor Co., advancing progressively from branch manager to vice-president in charge of sales in 13 states. During that time he specialized in helping fleet owners put commercial car operation on an efficient basis. He gained the name of "2500 Truck Phillips" through his work in establishing the largest single truck fleet in the western territroy.

White Managers Change

J. C. Rush, who has been district manager at Cincinnati for the White Co., has been appointed district manager at Detroit, taking the place of J. C. Compton who has resigned. E. B. Bergdoll has been made district manager at Cincinnati to take Mr. Rush's place.

A. F. Ling has been made branch manager at Toledo taking the place of W. M. Kelley, resigned. Mr. Ling has long been a star salesman at Cleveland and Mr. Bergdoll at Cincinnati. Both are members of the White club to which only those who have qualified as star salesmen may belong.

Mr. Rush has been a White salesman at Cincinnati since 1919. He was made branch manager April 1, 1919, and district manager at Cincinnati last October.

C. J. Evans in New Post

C. J. Evans, assistant sales manager of the Janesville branch factory of the Chevrolet Motor Co., has been appointed to fill the newly created position of city sales manager in Milwaukee, supervising the extensive community dealer organization in the metropolitan district. The growth of the business, dealer organization and the Chevrolet campaign to greatly increase distribution, has led to the new management plan. Mr. Evans has offices at 304 Century Building, Milwaukee.

Walton Joins Jackson Shaft

John R. Walton has accepted a position with the Jackson Motor Shaft Co. as general superintendent. He was formerly superintendent of the Lycoming Mfg. Co., builders of Lycoming engines. The Jackson company, with whom he has just affiliated himself, manufactures crank and cam shafts.

Abendroth Named Executive

Harry G. Abendroth has been appointed vice-president and sales manager of the All-Year Auto Enclosure Co., Milwaukee, in charge of Milwaukee and Wisconsin business. A Chicago office has recently been opened.

Industry Avoiding Heavy Steel Buying

Orders Are Held to Fortnightly Basis—Rollers Seeking Improved Prices

NEW YORK, Sept. 30—The end of September brings a repetition of the comments heard a month ago. Automotive demand proved much better than expected in both months, and now, as they did at the end of August, steel producers voice their preparedness for a slight tapering off in orders. Unwillingness to anticipate the future is just as pronounced among producers as it is among consumers. The latter place orders to satisfy requirements of their operating schedules during the ensuing fortnight; in some instances specifications indicate that the purchases represent the minimum of October requirements, so that if these automotive plants should speed up on their output in October, they will need additional steel tonnages.

Rollers of sheets and strip steel declare that they are unwilling to book orders at present prices for the entire fourth quarter. At the same time, concessions on the part of cold-rolled strip producers a week ago brought out a very large quota of business, and it is quite obvious that the strip steel mills were more anxious to get this business on their books than to risk delays in its being placed by seeking to obtain higher prices.

The latest asking price of some independent rollers of black sheets is 3.10 cents, No. 24 gage base. This implies a $5 per ton advance over the price in vogue before gages were shifted and prices lifted, and it is at the old price that virtually all the sheets now being shipped are billed. The tonnage booked at new prices is negligible so far, and, if, as so many consumers as well as producers believe, demand in October tapers off, the higher prices now being quoted will gradually give way, having served their purpose of driving out business at old price levels.

Full-finished automobile sheets are uniformly quoted at 4.25 cents for No. 20 gage. Producers of this body stock as well as strip steel finishers seek to dodge overexacting quality buyers who reject everything but prime material, but keep mum as to their special requirements when placing orders. Producers of billets and slabs are striving to advance their prices for these semi-finished descriptions used in strip steel production. Demand for cold-finished steel bars is well maintained at steady prices.

Pig Iron—The undertone of the market is decidedly more cheerful. Quite a little business from Middle West automotive foundries is under negotiation. The market is more nearly on a basis of $18, valley, for No. 2 foundry than $17.50, the quotation heretofore in vogue. Blast furnace interests were not eager for business at the latter figure.

Aluminum—Demand for foundry metal from the automotive industries is good. Accessory makers are buying remelted metal in a routine way. The import situation is unchanged. Every day brings nearer the influence on the market of the large production planned by the sole domestic producer for its Quebec plant which temporarily is being supplied with its raw material from East St. Louis, but eventually will receive direct bauxite shipments from Demerara, British Guiana.

Copper—Connecticut rolling mills show less interest in the copper market than they did earlier this month, apparently being convinced that no radical change in the price situation is to be apprehended.

Tin—While slight recessions are noted at times, the market on the whole continues prohibitive from a consuming point of view.

Lead—Storage battery interests look for cheaper metal, and are holding off for the time being.

Zinc—The market rules fairly easy.

Factory Should Plan Service Compensation

PHILADELPHIA, Sept. 28—Piecework compensation of mechanics was the subject discussed at the opening fall meeting of the Automotive Service Association of Philadelphia. The principal speaker was William G. Gow, general service manager of the Studebaker sales Co., of Newark, N. J.

Mr. Gow emphasized the difficulty of making money in the shop under any other method of compensation as there was no control over one of the largest cost items—labor. He outlined his system of operation and brought out how piece-work compensation simplified management problems. One of the important factors in the success of Mr. Gow's system is the use of planned advertising which assures a steady volume of business for his shop throughout the year.

Although the job of preparing the schedule of operations necessary was a big job, the results have been well worth the effort. In Mr. Gow's opinion, these schedules should be prepared by the factory and he expressed the hope that in the near future such work would be handled by the factory service department.

To Make Tires in Australia

LONDON, Sept. 18 (*by mail*)—The Rapson Tire & Rubber Co., (Australia), Ltd., with a capital of $5,000,000, is in course of formation. The factory is to be established in Tasmania, which, both from the standpoint of climatic conditions and of cheap electrical power, is said to be ideal. Sydney will be the distributing center.

The Tasmania government is rendering aid by supplying cheap power and by guaranteeing dividends of 8 per cent per annum over 7 years. All the patents, manufacturing processes and rights of the British Rapson company have been acquired. Distributors throughout Australia have already agreed to absorb 90 per cent of the output of 3500 tires a week.

Financial Notes

Federal Motor Truck Co. for seven months ended July 31, 1926, shows net income of $1,234,524 after depreciation, interest and Federal taxes, equivalent to $3.08 a year earned on 400,000 no par shares of stock. Income account for seven months ended July 31, 1926, follows: Gross, $8,447,751; expenses, etc., $7,075,149; operating income, $1,372,602; other income, $137,306; total income, $1,509,-908; depreciation, interest and Federal taxes, $275,384; net profit, $1,234,524.

Waukesha Motor Co. has declared a $1,000,-000 stock dividend payable at once together with a cash dividend. The action of directors is expected to be preliminary to the reorganization of the company for the purpose of listing its stock on some national exchange for the benefit of its stockholders. All of the outstanding preferred stock has been retired, this being made possible by the increase in surplus.

Siemens & Halske A. G. and Siemens-Schuckertwerke G.m.b.H., one of the largest electrical manufacturing concerns in Germany, and recently heavily interested in the manufacture of aircraft engines and airplanes are offering $24,000,000, 25 year, 6½ per cent sinking fund gold debentures through a number of American finance corporations headed by Dillon, Read & Co.

Goodyear Tire & Rubber Co. has called for payment Nov. 1, 1926, at $120 and interest, $750,000 of its 20-year 8s, due May 1, 1941, at the Central Union Trust Co., New York, or Union Trust Co., Cleveland.

Ford Motor Co. of Canada, Ltd., has dedeclared a 10 per cent dividend payable Oct. 11, to stock of record Oct. 1. The last payment was 10 per cent on Nov. 16, 1925.

Motor Lines Disastrous to Short Line Railroads

ASHEVILLE, N. C., Sept. 24—Arguments presented here before Commissioner John J. Esch and Chief Examiner Leo J. Flynn at the Interstate Commerce Commission hearing emphasized the understanding that the short line railroads of the Nation are in "an awful fix." None of the representatives of these interests could offer any solution of their problems, resulting from motor bus and private truck competition.

The principal argument of the short line railroads was that Federal control will tend to protect both the railroads and the motor truck and bus lines from preventing unfair competition through paralleling of lines.

Allis-Chalmers Expands

MILWAUKEE, Sept. 25.—Improvements costing more than $50,000 are being made in the nut and bolt shop of the main works of the Allis-Chalmers Mfg. Co. at West Allis. The shop is being enlarged as well as remodeled for greater production and efficiency. The Allis-Chalmers tractor works are a part of the West Allis plant, and the growing needs of the department are measurably responsible for the additional provision being made for bolt and nut output.

Studebaker Reduces Prices on Four Cars

SOUTH BEND, Sept. 27—Price reductions on four models have been made effective by Studebaker Corp. of America. These range from $35 to $205 and according to A. R. Erskine, president, are the result of an increased volume of sales, and are in keeping with the Studebaker policy of passing on to purchasers benefits resulting from increased production. Sales of sedans during September and August have been practically four times the sales of these models during the same period in 1925. Following is a list of the models affected:

	New Price	Old Price	Reduction
Standard Six			
Sport Roadster	$1215	$1295	$80
Country Club Coupe..	1260	1295	35
Big Six			
Country Club Coupe..	$1445	$1650	$205
Custom Brougham	1785	1985	200

N.A.P.A. Shows Sales Gain

DETROIT, Sept. 28—National Automotive Parts Association reports the average gross volume of business for its members and distributors in July and August as showing an increase of 13.69 per cent over the average monthly business in the first six months of the year. The first six months showed a gain of 25.58 over the last six months of 1925 according to C. H. Davis, executive secretary.

Fisher-Ohio to Build

CLEVELAND, Sept. 27—Three additional factory units and an extension of the main building will be built by the Fisher Ohio Body Co.. All work is to be completed about the first of next year. The office building will have a new extension 50 x 190 ft. and two stories high of brick, stone and structural steel. One of the new units will be used for storage of inflammable liquids, laundry and boiler house. This will be one story high, of brick, concrete, stone and steel and 50 x 400 ft.

Another press shop one story high and 80 x 120 ft. will be built in the rear of the present press shop which the plant has outgrown. The main building will be extended 24 ft. at each end, thereby completing the structure as originally planned.

Central European Roads to Open Travel for Cars

WASHINGTON, Sept. 29—A five year program of road repair, which has been started in Central Europe, will give that region a light but modern highway transportation system, including thousands of miles of motor roads which will make accessible to motorists many places difficult of access because of road conditions, according to a cable to the Department of Commerce from Pyke Johnson, secretary of the Highway Committee of the National Automobile Chamber of Commerce. Mr. Johnson is a member of the American delegation which recently attended the International Roads Congress in Milan.

Inspection of roads, particularly in Germany, Austria and Czecho-Slovakia, has impressed the Americans with the road possibilities in Europe, Mr. Johnson's cable states. The problem of repair is not a difficult one in most cases, the cable states, as even the oldest highways, built in the eighteenth century, have heavy stone foundations.

Harvey Spring at Capacity

RACINE, Sept. 25.—Further additions to the plant of the Harvey Spring & Forging Co. are in prospect as the result of the success the concern has met in the manufacturing and marketing of automobile bumpers. The new department was established several months ago and is now doing an international business. At the same time its business in automobile springs, both for factory equipment and replacement sales through jobbers, is growing to such an extent that more production is necessary.

Robins Belt Company Buys Hewitt Rubber

BUFFALO, Sept. 28—Control of the Hewitt Rubber Co., of this city, and its subsidiary, the Gutta Percha & Rubber Mfg. Co., of Brooklyn, has been acquired by the Robins Conveying Belt Co. President Thomas Robins, of the Conveying Belt company said that the entrance of his company into the rubber business was the final step in the achievement of its plan to manufacture every part of its belt conveyor in which a heavily padded rubber belt or band constituted about one-half of the total cost. The two rubber companies will continue to occupy the Hewitt plant here.

Thomas Robbins will be chairman of the board of the rubber subsidiaries, and Thomas Matchett, now vice-president and general manager of the Robins company, will also be president and general manager of the rubber companies. John H. Kelly and Frank V. Springer will be vice-presidents of the Hewitt company and Frank Miller and Amadee Spadone will continue in the management of Gutta Percha.

Make Multifuel Carburetor

DUNDEE, ILL., Sept. 25—The Mundhenk Multifuel Carburetor Company of this place has recently begun the manufacture of the Mundhenk carburetor which is claimed to produce combustible mixtures with fuels ranging from kerosene to gasoline and to be applicable to automobiles, trucks, tractors, airplanes, marine and stationary engine. Use of the carburetor is said to result in greater engine power and reduced fuel consumption.

U. S. L. to Assist Dealers

NEW YORK, Sept. 24—The annual sales conference of the USL service stations of the Metropolitan district was held at the Hotel Empire. D. H. Kelly, general manager, described the recent progress of USL and the increased activity of the company in the last year.

Developments of the Week in Leading Motor Stocks

NEW YORK, Sept. 30—There was little change in the nature of trading on the Stock Exchange during the past week and prices backed and filled as the bulls and bears struggled to bring prices of various issues to a more common level in relation to values.

This tendency was apparent in the price fluctuations of leading motor stocks. General Motors continued as the outstanding leader advancing into high ground. DuPont reflecting in part its equity in General Motors prosperity, also soared to new high levels. On the other hand Moon Motor declined to new low levels for the year anticipating a reduction in the dividend when directors meet early in October. A number of other issues held barely steady-around last week's prices.

Price reductions announced by Studebaker, following earlier downward revisions by Willys-Overland were interpreted as bearish factors in the motor situation. Increased competition is being discussed wherever speculators meet to review the motor outlook. The price cut put the brakes on the pool which started operations in Studebaker recently but this is expected to resume.

The tire stocks marked time during the week and reports are current that a reduction in prices to dealers will follow the recent reduction of manufacturers prices.

The motor truck stocks were still under liquidating pressure. While the recent move by Mack Truck to tighten credit requirements is expected to have a beneficial effect in the long run, the financial community believes its immediate effect will be to reduce sales. Yellow Truck was in fair supply. Reports from Chicago indicate that insiders have unloaded large blocks of stock since the issue crossed 30.

The accessory issues were featured by strength in Timken Roller Bearing. Important developments in connection with specially developed bearings for railroads are expected to be announced in the near future. Good buying entered Continental Motors on the expectation that some announcement will be made concerning contracts closed with large automobile manufacturers. Stewart-Warner continued to reflect liquidation.—E. S.

Sees African Market for New Small Cars

European Types Making Headway in Cities—Larger Cars Best in Rural Sections

NEW YORK, Sept. 25—There is a good potential market for the type of small car now being developed in this country in South Africa according to Maurice Edward, automobile dealer and writer of Johannesburg, who sailed today after a tour of portions of the United States and Canada. Mr. Edward said that in spite of the economy of the present type of European automobile, American cars are in the ascendency and comprise 90 per cent of the automobiles in use in his country.

Economical operation of automobiles is more important in Africa than elsewhere in the world because of the price of gasoline, he said. Prices of 60 to 80 cents a gallon prevail, much of the gasoline being supplied by American firms.

European types are making more progress in the large cities, said Mr. Edward, but in the rural sections the American car is so much better adapted to the requirements of the country that its gasoline consumption is disregarded. However, a car of high gasoline efficiency, and possessing other advantages of American design, would be ideally adapted to African highways, he declared. Africa has a used car problem but it is about three years behind the United States.

Due to the widely scattered population, there is not the degree of specialization in automotive merchandising such as here. He said the average car dealer acts as a wholesaler of replacement parts, accessories and shop equipment. The stores are well stocked and closely resemble those in America.

India Sales Increase 30%

NEW YORK, Sept. 24—Sales of motor vehicles in India are 30 per cent ahead of last year and, as the result of a trade-in situation similar to that in this country, the used car is becoming an increasingly difficult problem, according to Walton Schmidt, field representative of the National Automobile Chamber of Commerce, who is making an investigation of automotive conditions there.

Importers say that American manufacturers do not understand Indian conditions and in giving the country dealer more discount only aggravate the situation, declared Mr. Schmidt.

India is importing about 1200 passenger cars a month and about 500 buses and lorries.

N. Y. Considers Gasoline Tax

ROCHESTER, Sept. 24—The advisability of imposing a small tax on gasoline in New York to raise funds for traffic regulation and highway maintenance was considered at the public hearing of the Joint Legislative Motor Vehicle Committee here this week. Much difference of opinion was evident as to how the funds raised by the proposed tax should be employed. Representatives of motorists and automobile dealers opposed imposition of the tax, but the proposal was supported by representatives of the State Tax and Highway Commission, the Farm Bureau Federation and the New York State Grange.

The committee adjourned to meet at New York City for a second public hearing Oct. 1.

Canada Ships More Higher Priced Cars

OTTAWA, Sept. 25.—Statistics issued by the Canadian Government on Sept. 22 show that substantial increases have been made in the export of passenger and freight automobiles to all foreign countries this year.

For the 12 months ending Aug. 31, 1926, the number of passenger automobiles exported from Canada totaled 55,995, the value of which was $27,462,795, as compared with 48,304 valued at $22,646,541 for the previous 12 months. Motor trucks to the number of 19,760, valued at $6,756,585, were exported from Canada during the 12 months ending with last August. During the preceding 12 months, 14,007 trucks were exported by Canada, these being valued at $4,534,714.

Passenger car exports in August, 1926, totaled 2448, valued at $1,452,507 as against 2641 in July, valued at $1,028,286. Exports in August, 1925, total 2985, valued at $1,360,153. Truck exports in August were 597, valued at $218,078. This compares with 1517 valued at $519,321 in July and with 1410 valued at $401,088 in August, 1925. Gains in shipments of medium and high priced cars resulted in the increased valuation.

British India was the largest purchaser of Canadian vehicles during the month of August and other large buyers included New Zealand, Argentine, Japan, Dutch East Indies, Great Britain, British South Africa, Egypt, Brazil, Sweden and Belgium.

U. S. Leads in Egypt Sales

WASHINGTON, Sept. 24—Imports of automobiles into Egypt from the United States during 1925 totaled 1800 cars, out of total imports of 3000 cars, U. S. Consul Winship at Cairo has cabled the Automotive Division, Department of Commerce. Imports from the United States were valued at $1,500,000. Italy which supplied 550 cars, valued at $1,100,000 was the nearest competitor.

France Shows 146,370 More Cars

WASHINGTON, Sept. 24—Automobiles in use in France at the end of 1925 increased 146,370 over the number at the end of 1924, reports to the Automotive Division, Department of Commerce, show. The reports state that the figures for 1926 will show a further big increase.

Reeves Says Canada to Double Cars Soon

Needs Short Line Transportation by Automobiles to Perfect Development

WINDSOR, ONT., Sept. 25—That Canada is bound to double the number of its automobiles, was the prediction made by Alfred Reeves, general manager of the National Automobile Chamber of Commerce in a speech before the Rotary Club of Windsor, this week. Mr. Reeves came here to start a tour of Canada during which he will make a study of the automobile situation in the Dominion.

"Canada has a motor future surpassed by no other country in the world," Mr. Reeves declared. "Canada is on the threshold of a much extended automobile growth for several reasons. First of all, you have a splendid transcontinental railroad system which has been invaluable in building up your country. You are finding, however, just as we are learning in the States, that a country can be fully developed only in so far as it has short line transportation radiating from the railroad and supplying direct door-to-door service.

"Canada has a smaller ratio of motor vehicles to population than the United States, but its registration will be twice what it is today, and this doubling the use of motor vehicles in the Dominion, I predict, will come about within a very short time. In Canada you have conditions favorable to motor transportation exceeding the situation that exists in our country. We have great congested cities with a vast industrial population.

"In Canada you have a prosperous population, a great area and towns and cities of moderate and comfortable size. Motor travel under such circumstances is the logical and economic means of transportation over long distances."

200,000 Output This Year

Mr. Reeves then cited the fact that a large majority of automobiles used in the Dominion are manufactured in Canada. From 60 to 90 per cent of the parts used in Canadian manufacture are made in the Dominion. While 160,000 vehicles were produced by the Canadian plants in 1925, the number in 1926 should exceed 200,000, he said.

In conclusion, Mr. Reeves quoted a number of interesting facts and figures on the automotive business and its relation to Canada. He said the wholesale value of automotive products made in Canada last year totaled $110,835,380. A total of 1,101,618 automobiles have been manufactured in the Dominion since 1904. The annual payroll of Canadian automobile manufacturers totals $14,219,137. Of the automobiles produced in Canada, 45 per cent are consumed by foreign markets. There are 728,805 motor vehicles registered in Canada, of which 10 per cent are trucks.

A.E.A. Makes Ready Christmas Campaign

CHICAGO, Sept. 25—Preliminary announcement of a Christmas merchandising campaign to be conducted by the Automotive Equipment Association is made by Arthur R. Mogge, merchandising director. The central thought of the campaign, as heretofore, will be "Give something for the car this Christmas."

The merchandising department of the A.E.A. has prepared a variety of posters, price cards and Christmas window decorative material, in colors, which the members of the A.E.A. may purchase in quantities for distribution to dealers.

One item in the list of Christmas material will be a gift suggestion booklet naming accessories that may be purchased for different amounts. This booklet will be supplied to dealers for distribution to the public.

Five-Motor Hydroplane Shows Success in Test

WASHINGTON, Sept. 28—A five-motor hydroplane, said to be the largest and heaviest flying machine ever built, having a total weight of 17½ tons and a capacity for 20 passengers, has recently been given a successful test at St. Nazaire, France, H. H. Kelly, American Trade Commissioner at Paris, reports to the Department of Commerce. The plane is a product of the Penhoet shops. Each of its five motors has 420 horsepower.

Milwaukee Plant Sold

MILWAUKEE, Sept. 25.—The Lutter & Gies Co. has disposed of its business to the Milwaukee Press & Machine Co. The two operations are being consolidated in the Lutter & Gies plant, the acquisition by the Press & Machine company having developed from its urgent need for more manufacturing space. Anson Eldred is president of the Milwaukee company.

Coming Feature Issues of Chilton Class Journal Publications

Nov. 4—Motor World Wholesale. Annual Marketing Issue

Jan. 1—Automobile Trade Journal. Annual Show Issue

Jan. 6—Motor Age. Annual Show Issue

Buick Starts New Foundry to Make All Own Castings

FLINT, Sept. 24—Ground has been broken for a new gray iron foundry for the Buick Motor Co. which will cost $5,000,000. The new unit will add approximately 1700 workers to Buick's payroll, according to Harry H. Bassett, president and general manager.

Buick has found it necessary to purchase large quantities of castings from other cities because the present foundry lacks facilities for turning out an amount required for Buick's greatly increased production. The new foundry is designed to eliminate these outside purchases.

The new foundry will have a floor space of 12 acres and will have a daily capacity of 500 tons, in addition to the output of the present foundry. It will be one of the largest gray iron foundries in the United States.

Georgia to License Drivers

ATLANTA, Sept. 25.—An automobile driving license law similar to those in force in several states will be introduced in the 1927 legislature here as a result of increasing numbers of automobile accidents in Atlanta and other cities of the State, and will probably be passed without serious opposition.

1926 Radio Business to Reach $500,000,000

NEW YORK, Sept. 27—Predictions are being made in radio circles that 1926 business in this country will reach a total of $500,000,000, which compares with $350,000,000 in 1925, $300,000,000 in 1924, $120,000,000 in 1923, $60,000,000 in 1922, $5,000,000 in 1921 and $2,000,000 in 1920. Indications are that probably 40 per cent of the total annual business will be done the last three months of this year, as in past seasons. If anything, the seasonal aspects of the industry are more in evidence than heretofore.

An interesting phase of the business is that there are fewer and better receivers offered this year than in the past. This is due to the elimination of the weaker manufacturers and the concentration of business in the hands of the stronger minority.

Estimates place the number of receivers in use in the United States today at about 5,000,000, with probably 25,000,000 people listening in when special country-wide programs are broadcast, such as the recent Dempsey-Tunney fight reports.

Acklin Stamping Builds

TOLEDO, Sept. 25—Acklin Stamping Co. has increased its production capacity by 50 per cent through the addition of a large number of die-making machine tools. The company reports August as its largest production month with a bid demand for pressed metal promising to continue.

Highway Opens New Branch

CLEVELAND, Sept. 28—The Highway Trailer Co., of Edgerton, Wis., has opened a branch office and warehouse here. E. J. Shaffrank is in charge. A stock of trailers and parts will be carried and a service station maintained.

Calendar of Coming Events

SHOWS

Boston, Mass. .....Sept. 27-Oct. 2
Radio Exposition, Mechanics' Bldg.
Brussels .....Dec. 4-15
Buenos Aires .....Dec. 7-20
Ninth Argentine Automobile Show, Palermo Park.
Cairo.....Feb. 15-March 15
First International Motor Show.
Chicago.....Sept. 27-Oct. 2
National Radio Exposition.
Chicago .....Nov. 8-13
Coliseum, Automotive Equipment Association.
Chicago .....Nov. 8-13
Accessory Exhibit, Armory.
Chicago .....Nov. 15-19
Hotel Sherman, National Standard Parts Association.
Chicago .....Jan. 10-15
Coliseum, American Road Builders' Association.
Chicago .....Jan. 29-Feb. 5
National, Coliseum, National Automobile Chamber of Commerce.
Chicago .....Jan. 29-Feb. 5
Annual Salon, Hotel Drake.
Cleveland .....Oct. 4-8
Public Auditorium and Annex, American Electric Railway Association.
London .....Oct. 4-9
Olympia Motor Cycle.
London .....Oct. 21-30
Los Angeles .....Feb. 12-19
Annual Salon, Hotel Biltmore.
New York .....Oct. 20-30
Electrical and Industrial Exposition, Grand Central Palace.
New York .....Nov. 24-Dec. 4
Annual Salon, Hotel Commodore.
New York .....Jan. 8-15
National, Grand Central Palace, National Automobile Chamber of Commerce.
Paris .....Oct. 7-17
Auto Salon, Grand Palais.
Paris .....Dec. 3-19
International Aeronautic Exposition, Grand Palais.
Ponce, Porto Rico .....Dec. 1-12
San Francisco .....Oct. 7-15
All-Western Road Show.

CONVENTIONS

American Electric Railway Association, Public Auditorium and Annex, Cleveland .....Oct. 4-8
American Road Builders' Association, Congress Hotel, Chicago .....Jan. 10-15
American Welding Society, Broadway Auditorium, Buffalo .....Nov. 17-19
Associated Manufacturers of Fabric Auto Equipment, Inc., La Salle Hotel, Chicago .....Nov. 13
Automotive Accessories Association, Chicago .....Nov. 8-13
Automotive Equipment Association, Coliseum, Chicago .....Nov. 8-13
The Motor and Accessory Manufacturers Association, Credit Conference, Hotel Statler, Cleveland .....Oct. 20-22
National Association of Finance Companies, Palmer House, Chicago, Nov. 15-16
National Standard Parts Association, Hotel Sherman, Chicago.....Nov. 15-19
National Tire Dealers Association, Inc., Memphis, Tenn. .....Nov. 16-18
Society of Automotive Engineers, National Transportation and Service, Boston .....Nov. 16-18

RACES

Dallas, Texas .....Nov. 11
Laurel, Md. .....Oct. 23
Los Angeles .....Nov. 25
Salem, N. H. .....Oct. 13